■ Tracer-light photo made with flashlights attached to fork tips, showing range of handling motions with the Baker "Octopus."

This BAKER TRUCK handles any shape load...

and stacks it in any position!

■ You name the load—the Baker "Octopus" illustrated will handle it, whether it's a drum, a roll of newsprint, a packing case, a piece of machinery, a bale of cotton or a pallet load of cartons. Moreover, it will pick it up, transport it, raise or lower it, shift it to left or right, revolve it, up-end it, or stack it in any position. In fact, it will handle it with no more physical effort than is needed to operate the simple hydraulic controls.

The "Octopus" consists of a standard Baker Fork Truck equipped with a variety of Baker attachments—360° revolving head, 4-purpose carriage, up-ender, drum clamp, etc.—which may be applied individually or in combinations. While one truck may never be called on to perform all these functions, the "Octopus" demonstrates the range of utility of Baker fork trucks and attachments.

write for *6-page special report on the application of Baker attachments to various loads.*

Baker
industrial trucks

THE BAKER-RAULANG COMPANY
1251 WEST 80th STREET • CLEVELAND 2, OHIO

BAKER-LULL Corporation, *Subsidiary*, Minneapolis, Minn.
Material Handling and Construction Equipment.

For more facts circle 502 on Reply Card

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'ROUND ABOUT with the editors in field and office

Edited by R. L. Marinello

Nominate Plant Engineer Director at Large of ASME

F. L. Bradley, engineering manager of the Forstmann Woolen Co., Passaic, New Jersey, was recently nominated to serve as Director at Large of The American Society of Mechanical Engineers for a four-year term.

He joined Forstmann Woolen Co. in 1931 as assistant plant engineer, later becoming plant engineer, and currently engineering manager of the company. During this period, he has been responsible for the construction as well as the maintenance and operation of these facilities. His work has covered a broad scope of industrial operation and design, including the development of many textile units which have been patented by the company.

He became a junior member of the Society in 1920; a member in 1930; and a life member in 1952. Mr. Bradley has been active in the Metropolitan Section in the capacity of both treasurer, 1951-1952, and chairman, 1952-1953 and has served as a member and chairman of the ASME Textile and Power Division.

Do You Have a Metal Problem?

AN ENGINEERING appraisal service covering the whole range of created metals is offered to American industry by the Carboloy Department of General Electric Co. The Carboloy engineering staff will aid manufacturers in solving problems in areas ranging from permanent magnetism to high temperature structural materials.

The project extends over the following fields as well: corrosion and friction-wear resistance, metal cutting and forming and temperature control.

Readers interested in more information about this engineering appraisal service may write to Carboloy, Department of General Electric Co., Detroit 32, Mich.

New Plants Under Construction

Barrett-Cravens Co. is constructing a modern manufacturing plant at Northbrook, Illinois, which will combine the operations of the two Chicago plants and part of the operations of the **Crescent Truck Co.,** a subsidiary . . . **Cramet, Inc.,** wholly owned subsidiary of **Crane Co.** of Chicago, will increase production of titanium by 6,000 tons annually upon completion of new plant being built in Chattanooga, Tennessee . . . **Nox-Rust Chemical Corp.** will be able to step up production by 100 per cent upon final completion of its new plant at 47th St. and Central Ave., Chicago . . . Plastic pipe and fittings are being pr oduced at the new plant of **Carlon Products Corp.** situated in Klamuth Falls, Oregon . . . Construction of an automotive storage battery plant for **Gould-National Batteries** will begin soon on a new site in Houston, Texas . . . **Cummins Engine Co., Inc.,** is expanding its plant facilities with the erection of a three story building alongside its plant in Columbus, Indiana . . . **Milwaukee Gear Co.** has selected a suburban setting outside Milwaukee for its new plant . . . Construction work is proceeding on schedule on **Westinghouse Electric Corporation's** Atomic Equipment Department plant in Harmar Township, near Pittsburgh, Pa. . . . **Bird and Son, Inc.,** will build a new roofing and granule plant at Charleston, South Carolina.

Photographic Inspection

HIGH-SPEED PHOTOGRAPHY and time-lapse photography are now offered as unique field service tools to observe and analyze the action of rapidly-moving machine parts.

These high-speed motion pictures show clearly and in detail the actions of any body or mechanism moving at either constant or changing high velocities. This photographic process can "slow down" time by a factor as large as 200, so that, for example, an action normally occurring in one second can be expanded into a clearly-followed slow-motion sequence of about three minutes.

One application of this technique was the study of a cam and follower designed to make and break a pair of electrical contacts 500 times a minute—or about eight times a second. On the basis of the picture-study, the cam mechanism was redesigned.

Among other types of studies for which high-speed photography is suited are the formation of chips on high-speed cutting tools, vacuum metallization, high-frequency reciprocating motions, breakage problems, explosion phenomena, ballistics, and all types of industrial and scientific problems involving high-speed motion.

Further information about the types of industrial studies now possible with these photographic techniques can be obtained from Sam Tour and Co., Inc., 4 Trinity Place, New York 6, N. Y.

Chicago Club Studies Plumbing

INCLUDED on the program of the second meeting of the Chicago Plant Engineers' Society on October 2, was a visit to the Plumbing Testing Laboratory of Chicago. The host at this time was Mr. E. J.

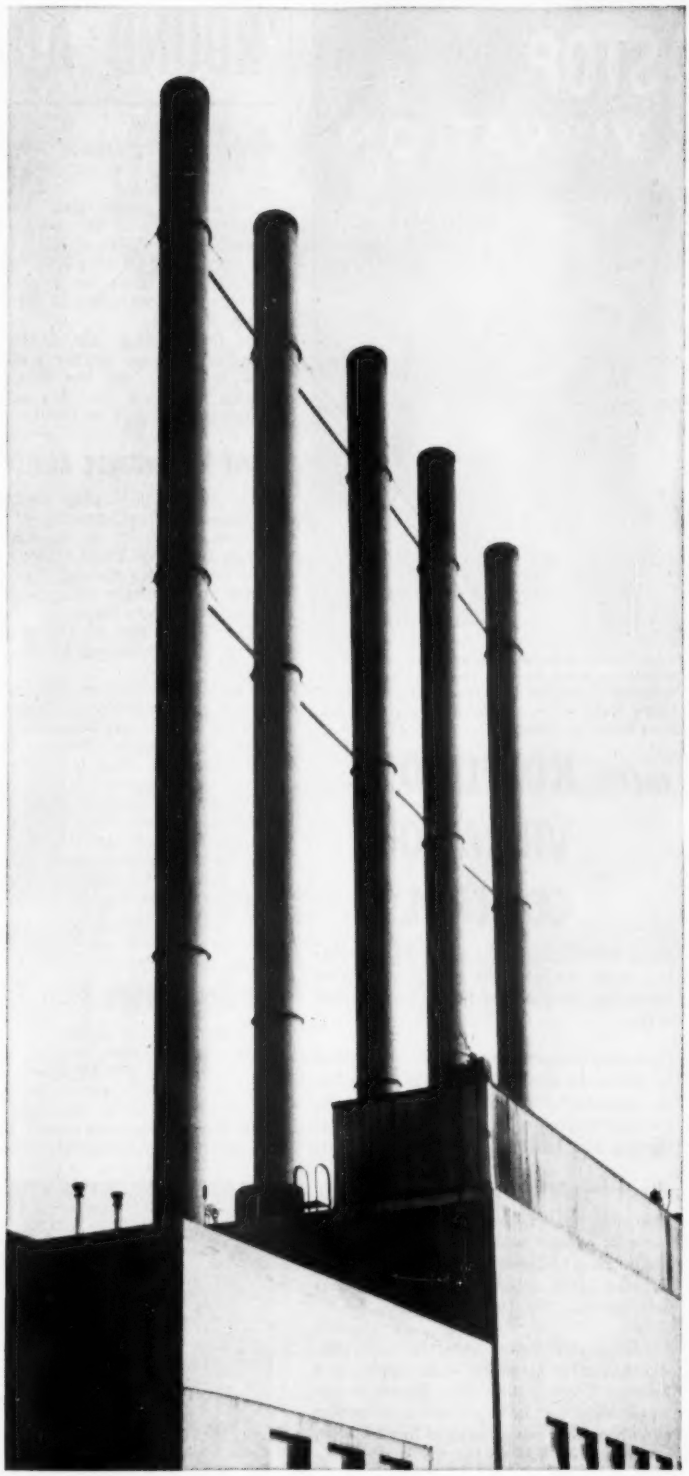
Plant Engineering is published monthly at Chicago, Ill. Subscriptions one year $10 in the U. S. A. Canada $11; Elsewhere $12. Acceptance under Section 34.64, P. L. & R. authorized by Post Office.

This Modern Chemical Producing Plant Used

BYERS WROUGHT IRON PLATES

TO KEEP THEIR STACK INVESTMENT FROM GOING

"UP IN SMOKE"



Because stack maintenance comes high, engineers of this modern chemical producing plant got "down to earth" facts before they selected material for the five new stacks at the Company's Chemical Plant, Louisville, Kentucky.

A thorough investigation of wrought iron's corrosion resistance, and past records of the material in stack service, indicated wrought iron plates as a solution to excessive maintenance and repair. The stack fabrication and erection job was turned over to W. E. Caldwell, Louisville. The stacks are 126 feet high and 54 inches in diameter.

With today's high maintenance costs, it's just plain good business to assure that every metal stack lasts as long as possible, with as little attention as possible. The importance of this move increases as stacks grow taller, for the higher the stack—the higher the cost of maintenance.

Byers Wrought Iron plate is a veteran in stack service. Engineering records provide convincing evidence of its superior durability. You can review some of these records, and see how wrought iron has helped others solve the problem of premature failure and maintenance by writing for a copy of our bulletin, WROUGHT IRON FOR FLUE GAS CONDUCTORS AND COAL HANDLING EQUIPMENT. It may help you . . . so write today.

A. M. Byers Company, Pittsburgh, Pa. Established 1864. Boston, New York, Philadelphia, Washington, Atlanta, Chicago, St. Louis, Houston, San Francisco. Export Division: New York, N.Y.

BYERS

CORROSION COSTS YOU MORE THAN WROUGHT IRON

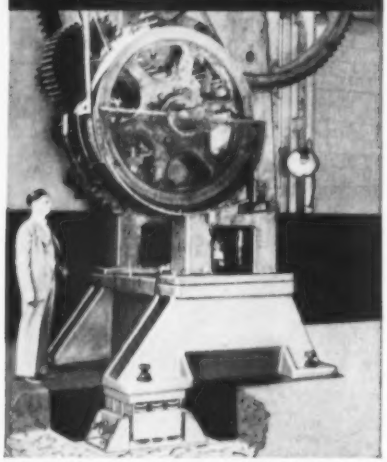
WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

ELECTRIC FURNACE QUALITY ALLOY AND STAINLESS STEEL PRODUCTS

For more facts circle 503 on Reply Card

STOP VIBRATION



Huge 600 ton capacity press weighing 100,000# at Hawthorne Metal Products Company, Royal Oak, Michigan. Special 25,000# capacity Korfund Steel Spring Vibro-Isolators installed directly under the press weigh 600# each.

with KORFUND VIBRATION CONTROL

Shock from this big press was cracking building walls. To maintain heavy production schedules, this condition had to be remedied — fast.

Korfund's Detroit representative was called in, analyzed the problem, and 'phoned in the important data to the Korfund factory. Korfund engineers immediately started designing and building the special Isolators.

Seven days later, they were shipped!

This press has now been in daily operation for over a year, and shock transmission to the building has been completely eliminated. Yet the 100% effective Korfund Isolators cost less than 3% of the press cost.

For less critical installations, there are even less expensive standard stock Isolators. A Selector Chart is available, giving recommendations for both normal and critical conditions. See our catalog in Sweet's Files, or write us for Bulletin No. 8.

We'll gladly submit recommendations, without obligation. A half century of experience is at your disposal.

THE KORFUND CO., INC.

KORFUND VIBRATION CONTROL — SPRINGS — RUBBER — CORK

48-38th Thirty Second Place, Long Island City 1, N. Y.
In Canada: 510 Canal Bank, Ville St. Pierre, Montreal

For more facts circle 504 on Reply Card

'ROUND ABOUT

Zimmer, the laboratory director, who gave an interesting and informative lecture on plumbing.

Before his main talk, the director asked members of the group to gather in one of the display rooms where mock-ups and examples of plumbing technique are located. Here, he pointed out and discussed various types of pip: joints on water lines.

In the evening, Mr. Zimmer was a guest at a dinner meeting; at this time, club members had the opportunity to clarify some of the things that they witnessed or heard at the laboratory.

Plant Maintenance Course

IN COOPERATION with the College of Engineering, the University of Wisconsin Extension Division is planning an Institute in Industrial Plant Maintenance to be held December 9 through 11.

An outline of the subjects that will be discussed is given below and will give the reader some idea of the many phases which will be covered in this three day period.

The two sessions on the first day will consist of Establishing a Good Maintenance Program and Planning and Scheduling Maintenance Work. Discussions under each of these subjects will consider: Organization of Maintenance Department; Training of Personnel; Relationship between Plant Engineering and Design Engineering; Working Relationship between Maintenance Planning Egineer and Production Department; Planning or Scheduling Machine Repair to Coincide with Production Slowdown and Establishment of Job Priorities.

Planning and Scheduling Maintenance Work and Maintenance Costs and Budgets will be discussed on the second day. Subjects under each of these categories will include: Maintenance Scheduling and Records; How Inspection and Preventive Maintenance Can Save You Money; The Importance of Equipment Records; Painting—Its Place in Modern Plant Maintenance; Classification of Jobs—Repair or Replacement; Placement of Responsibility for Maintenance Costs; and The Importance of a Work Order System in Cutting Maintenance Costs.

First portion of the third day will finish the previous day's discussion of Maintenance Costs and Budgets and will then consider Work Measurement of Maintenance Activities. Answers to such questions as Can Work Measurement Be Applied to Maintenance? and Can Incentives Reduce Maintenance Costs? will be thrashed out as the final session of this instruction period.

Electrical Engineers' Conference

MORE THAN 400 papers will be presented at the 90 sessions and conferences of the Winter General Meeting of the American Institute of Electrical Engineers in New York, January 18 through 22. The majority of sessions and conferences will be held in the Statler Hotel, with the overflow in the McAlpin Hotel and the Engineering Societies Building at 33 West 39th St.

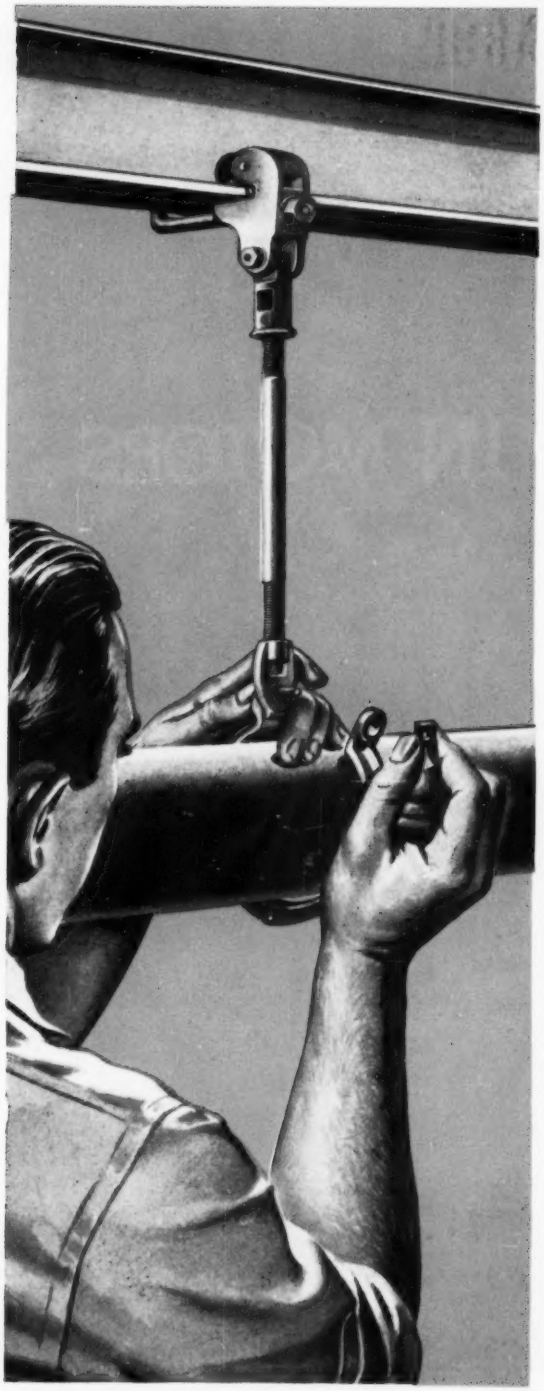
In addition to the technical sessions and conferences, the meeting will also feature a general session with addresses by Elgin B. Robertson, Dallas, Texas, President of the Institute, and other prominent speakers. Inspection trips to industrial sites in the Metropolitan area are also planned.

Northern Illinois Plant Engineers' Group Sponsors Civic Activity

EXTENDING ITS ACTIVITIES outside the usual plant engineer's scope of responsibility, the Plant Engineers' Society of Northern Illinois sponsored a booth at the recent Industrial Fair held in Waukegan, Illinois. Located among the exhibits of many of the companies represented in their membership, the booth featured the symbol of their organization. This symbol, a gear, had been "motorized."

Surrounding the gear were placards showing names of the manufacturing companies from whose engineers the Society's membership is drawn.

Members of the Northern Illinois Society manned the booth during the Fair. Pictured are (l to r) Sig Simonson, President, Leroy Puzin, and Joe Church, Secretary



Right for the job and priced right!

There's nothing sensationally "tricky" about this pipe hanger. It's just the most practical and inexpensive way of hanging pipe for a great many jobs. Complete assembly includes a split pipe ring and socket, rod, extension piece and universal I-beam clamp. Available for pipe from ½" to 8", for loads from 75 to 1510 lbs.

It is well worth remembering that a good piping job is too important to jeopardize with improvised or inadequate pipe hangers and supports. You can get from Grinnell just the right pipe hanger for any job within the shortest possible time at the lowest cost consistent with quality.

Grinnell has the most complete line of pipe hangers, extensive manufacturing facilities, warehouses across the country, and jobbers in almost every city and town.

UNIVERSAL SIDE I-BEAM MALLEABLE IRON CLAMP (Fig. 225) . . . Used on American Standard I-beams as well as wide flange beam sections. One of 14 different Grinnell beam clamps to meet varying specifications.

MALLEABLE IRON EXTENSION PIECE (Fig. 157) . . . Bolts into Universal Side I-beam Clamp (Fig. 225) and other malleable iron clamps to receive hanger rod. Provides for adjustment of rod.

MALLEABLE IRON SPLIT PIPE RING AND SOCKET (Fig. 107R) . . . Once hanger rod is turned to proper adjustment and the attached half of the ring is snugged against the pipe, the other half of the ring is swung up into position and bolted. For 13 pipe sizes, ½" to 8", for loads from 75 to 1510 lbs.

GRINNELL

WHENEVER PIPING IS INVOLVED

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

Manufacturer of: pipe fittings • welding fittings • forged steel flanges • steel nipples • engineered pipe hangers and supports Thermolier unit heaters • Grinnell-Saunders diaphragm valves • prefabricated piping • Grinnell automatic fire protection systems

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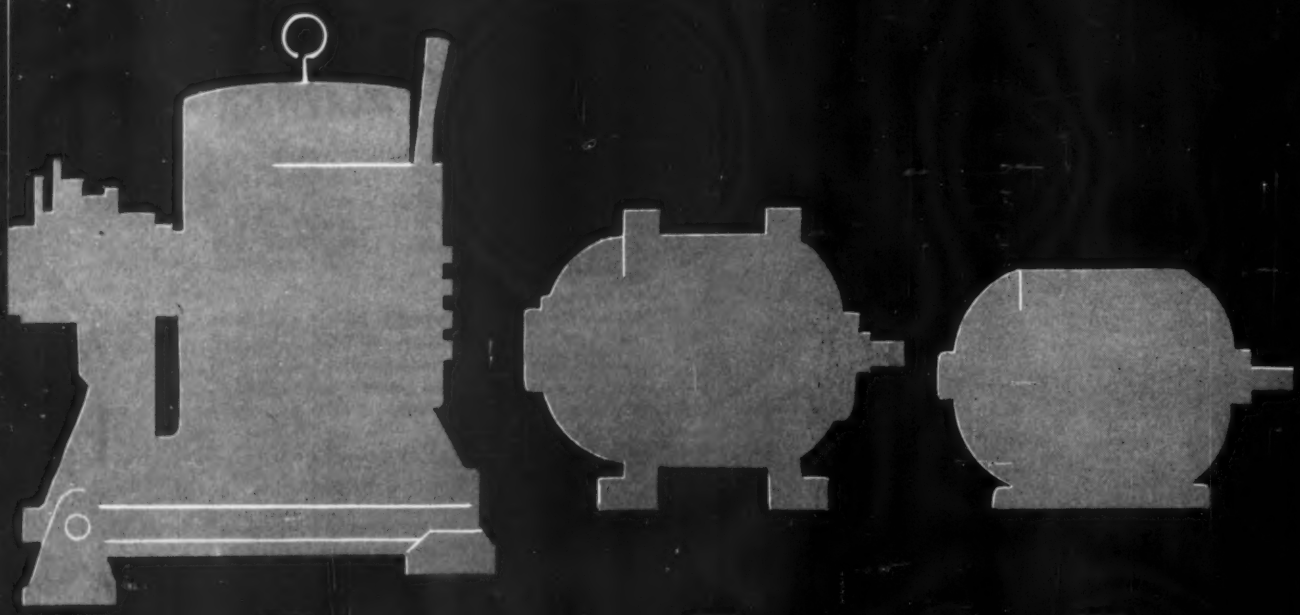
WHAT'S NEW IN MOTORS



1888
TESLA
5 H.P.
765 LBS.

1926
CS
5 H.P.
130 LBS.

1947
LIFE-LINE
5 H.P.
119 LBS.

IS STILL TO COME . . .

Hear anything about a new motor? Well, if you think you have, let's set the record straight . . . What's New In Motors Is Still To Come!

Westinghouse has been a leader in the designing and manufacturing of motors for over 60 years. During these many years, over 20 million dollars has been spent on the development of basic lines of induction motors to maintain this leadership. Here are the real years of "new motors" in the parade of progress:

1888—*THE FIRST A-C MOTOR—THE WESTINGHOUSE TESLA MOTOR*

1926—*THE FIRST SEALED SLEEVE BEARINGS—THE WESTINGHOUSE CS MOTOR*

1947—*THE FIRST MOTOR WITH PRE-LUBRICATED BEARINGS PLUS A ⅓ WEIGHT AND SIZE REDUCTION—THE WESTINGHOUSE LIFE-LINE MOTOR*

The smaller, lighter Westinghouse Life-Line Motor of 1947 was the last major contribution. *AND FOR THE NEXT ALL-IMPORTANT STEP AHEAD IN MOTOR PROGRESS . . . LOOK TO WESTINGHOUSE.*

YOU CAN BE SURE.. IF IT'S Westinghouse

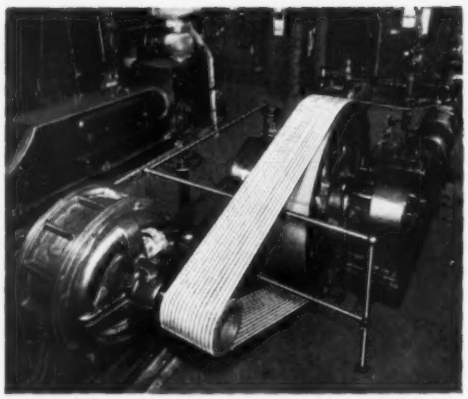
J-21834

To see how the CONCAVE SIDE lengthens Belt Life...

—take any *straight-sided* V-Belt (Fig. 1). Bend it—as if it were going around a pulley. The sides will at once *bulge out* (Fig. 1-A)—and this causes *extra wear* where the bulge is greatest. (See arrows.)

Now bend a Gates Vulco Rope with CONCAVE SIDES (Fig. 2)

You will see the precisely engineered CONCAVE SIDES fill out to an exact fit in the sheave-groove (Fig. 2-A). The sides press *evenly* against the V-pulley. All wear is distributed *uniformly* across the *full width* of the Gates Vulco Rope—and this means longer belt *life* and *lower* belt *costs* for you.



Typical Gates Vulco Rope Drive—the Gates V-Belts are built with Concave Sides to insure longer belt wear.

When you buy V-Belts, be sure to get the V-Belt with the CONCAVE Sides—the Gates Vulco Rope!

Gates Engineering Offices and Jobber Stocks are located in all industrial centers of the United States and in 71 foreign countries.

CS-5311

V-Belts—Hose
Molded Rubber Goods
for Industry
World's Largest Maker
of V-Belts

Gates® VULCO ROPE DRIVES

THE GATES RUBBER COMPANY • DENVER, U.S.A.

For more facts circle 507 on Reply Card

SQUARE D "PLUG-IN" Control Centers

at left • Control center with main breaker, metering panel, 33 combination starters and 6 branch breakers.

at right • beginning of a processing line in the Fairlawn Finishing Company, Fairlawn, New Jersey. Square D control center, compact and out of the way, provides control of all automatic operations in applying water-repellent finish on nylon.

for ECONOMY · SAFETY · FLEXIBILITY

ECONOMY in installation because factory assembly has done most of the work of mounting and wiring individual motor starters. For easy wiring, large vertical and horizontal gutters are front accessible without removing units. Economy of space because standard 20"W x 20"D x 90"H sections accommodate up to six combination motor starters.

SAFETY because bus structure is rigidly supported on porcelain insulators and is designed to withstand short circuits up to 25,000 amperes. Safety because dead front handle mechanism always indicates true position of circuit breaker or switch and can be locked off with one to four padlocks.

FLEXIBILITY because plug-in units may be removed, added or exchanged at will. Both fusible switch and circuit breaker types are available. Flexible because standardized sections and units are always re-usable after plant conversion.

Your nearby Square D Field Engineer will give you the complete story . . . or write for BULLETIN 8938. Address **Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin.**

ASK YOUR ELECTRICAL DISTRIBUTOR FOR SQUARE D PRODUCTS

SQUARE D COMPANY

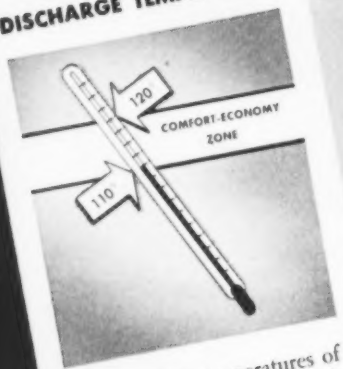
1903 • 50 YEARS OF DESIGN LEADERSHIP • 1953

Before you buy any unit heater

Compare

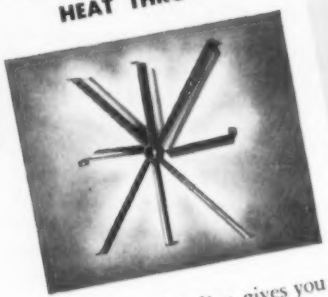
MODINE STEAM and HOT WATER units that top the field

Compare
DISCHARGE TEMPERATURES



Discharge air temperatures of 110° to 120° F. are correctly related to air velocities — the key to perfect heating comfort plus lower fuel costs.

Compare
HEAT THROW



No one but Modine gives you a built-in velocity generator that effectively steps up heat throw, assures positive heat penetration of cold air strata near floor.

In addition to horizontal delivery models, Modine offers a new line of vertical units for both steam and hot water. New, improved design is lighter, smaller, yet gives you *greater* capacity.

Compare LONG LIFE

Modine's advanced engineering is combined with superb styling and highest grade materials. Your assurance of long years of trouble-free service. *But see for yourself!* Call the Modine representative listed in your phone book, or write for Bulletin 153 on Modine Steam and Hot Water Unit Heaters.

Modine

...steam, hot water or gas...

Modine WITH ALL OTHERS!

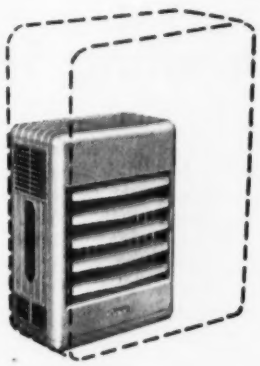
Modine Gas-Fired Unit Heaters are built in a full range of popular sizes. All are A.G.A.-approved for natural, mixed, manufactured, L.P. and L.P.-air gases.

GAS-FIRED units that top the field . . . with *stainless steel* heat exchangers and burners

Compare

EASE OF INSTALLATION

Advanced stainless design makes Modines 50% lighter in weight—more compact than the average of seven other leading makes. Installation is faster, easier — no need for special structural supports. On one job, it cost the heating contractor $600 less to install 66 Modines than conventional units — savings he passed on to the owner.



Compare

PERFORMANCE

EVEN HEATING | MODINE | CONVENTIONAL

Not only do Modine units resist corrosion — all tubes heat uniformly because they're individually fired. Burners have elongated ports with four times the free area of ordinary drilled ports for maximum combustion efficiency. Remember: with Modines you are *sure* of getting full rated capacity.

U-1202

Compare **ALL-AROUND VALUES**

As the leader in the development and application of steam and hot water unit heaters for more than 25 years, Modine brings unequalled experience to gas unit heating problems. It is the *only* manufacturer to publish heat throw data for gas-fired units. For facts, ask for Bulletin 653. Modine Mfg. Co., 1563 DeKoven Avenue, Racine, Wisconsin.

UNIT HEATERS

For more facts circle 510 on Reply Card

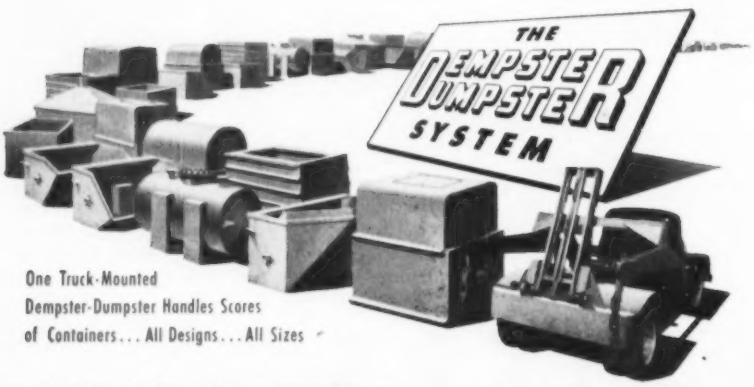
Here's a One-Man Bulk Materials Handling System for Your Plant...

In the Dempster-Dumpster System of bulk materials handling only one man, the driver of the truck-mounted Dempster-Dumpster, is required for operation. The Dempster-Dumpster serves scores of detachable Dempster-Dumpster Containers. Container capacities range up to 4 times that of conventional dump truck bodies and each container is designed to suit the materials to be handled—be they solids, liquids or dust . . . hot or cold . . . bulky, light or heavy. You simply place these containers at convenient materials accumulation points inside or outside buildings. When loaded each container is picked up, hauled and emptied (as shown above) or load set down intact. Entire operation is handled by hydraulic controls in cab.

Containers shown below are just a few of the many available or that can be built to meet your needs. They enable you to handle, at tremendous savings, materials of many descriptions—trash and waste materials, raw materials, finished products, etc. —with only one truck and only one man, the driver.

Without question, the Dempster-Dumpster System is the most economical and most efficient method of plant materials handling by truck ever devised!

Write to us for complete information. Manufactured exclusively by Dempster Brothers, Inc.



One Truck-Mounted Dempster-Dumpster Handles Scores of Containers... All Designs... All Sizes

DEMPSTER BROTHERS, 1123 Shea Bldg., Knoxville 17, Tennessee

For more facts circle 511 on Reply Card

Despite cleanliness and efficiency of a midwest firm's Plastic Division, shown above, there was "dirty work" afoot in the hydraulic systems of the injection molding machines. Division superintendent (left) and A. L. Seabaugh, of Standard Oil, came up with a solution.

Stops "dirty work" in hydraulic units

● A midwest company became increasingly aware that hydraulic oil performance in its fourteen injection molding machines was not all that it should be. Formation of oil deposits not only made frequent cleaning of filters necessary but posed a threat to efficient operation of the hydraulic units.

A Standard Oil lubrication specialist recommended STANOIL Industrial Oil, a top quality product of exceptionally high stability and containing necessary additives to prevent corrosion and oxidation troubles.

Throughout six years of continuous hard use, STANOIL has provided clean operation. It has not been necessary to replace any of the original fills of STANOIL, and only a small amount of make-up oil has been needed. Where filters previously had to be cleaned at least four times a year, they are now cleaned once each year. Hydraulic operation has been efficient and reliable.

STANOIL
TRADE MARK
Industrial Oil

You can rely on STANOIL to give you the same clean, dependable service not only in hydraulic units but in a wide variety of equipment. You can get the help of the Standard Oil lubrication specialist serving your section of the Midwest by phoning your local Standard Oil office. Or, write: Standard Oil Company, 910 S. Michigan Ave., Chicago 80, Illinois.

What's YOUR problem?

A. L. Seabaugh, working out of Standard's Chicago office, is the lubrication specialist who helped this midwest firm gain both operating and maintenance benefits through use of STANOIL in hydraulic units.

Located throughout the Midwest is a corps of specially trained, experienced Standard Oil lubrication specialists, ready to give you prompt, on-the-spot help with lubrication in your plant. Their broad background of practical experience, plus their thorough training in Standard Oil Lubrication Engineering Schools, is yours for the asking. Simply phone your nearest Standard Oil Company office. The lubrication specialist will call without delay. He has a complete line of petroleum products to offer, including such outstanding lubricants as:

SUPERLA Greases — Available in a wide range of consistency grades and in both lime-soap and soda-soap types. SUPERLA Greases cover a wide range of operations. These efficient products are comparable in quality with the highest type of special greases.

STANOLITH Greases — Because these unique lithium soap products possess the heat resistant properties of soda-soap greases and the water resistant properties of lime-soap greases, they offer a solution to lubrication problems caused by the presence of both heat and water.

STANDARD OIL COMPANY

STANDARD (Indiana)

For more facts circle 512 on Reply Card

THE GREATEST SHOWING OF INDUSTRIAL RUBBER PRODUCTS ON EARTH
REPUBLIC RUBBER
WIRETEX
M.P. STEAM
YOUNGSTOWN, OHIO
1. Special heat-resistant cover compound, firmly bonded to carcass.
2. Non-charring asbestos cords interbraided with wires which dissipate static electricity.
3. High adhesion between plies provided by special insulative compound.
4. Steel wires of high-tensile strength braided to resist high steam pressures and make hose Burst-Proof.
5. Heat- and oil-resisting inner tube retains resiliency under high-pressure steam.

SAFETY IS YOUR CONCERN!

Your employees rightfully expect you to furnish them with the Safest tools available . . . including Steam Hose that Will Not Burst!

WIRETEX Steam Hose **will not burst . . . can not** suddenly spray out super-heated steam, blinding steam, maiming steam; yes, even killing steam.

For what you are now paying for ordinary steam hose, you can insist upon getting WIRETEX Steam Hose . . . with a Safety Factor far beyond that provided by ordinary steam hose specifications.

Ask your local Republic Rubber Distributor. If his name is not listed in the yellow pages of your telephone directory, write directly to us.

REPUBLIC RUBBER DIVISION

LEE RUBBER & TIRE CORPORATION, YOUNGSTOWN 1, OHIO

INDUSTRIAL RUBBER PRODUCTS

For more facts circle 513 on Reply Card

HALL INDUSTRIAL WATER REPORT

Hall Laboratories, Inc.—A Subsidiary of Hagan Corporation, Pittsburgh, Pa.

Volume 1 | DECEMBER 1953 | Number 6

Zeolite Double Trouble Solved

A utility plant has solved a bothersome two-way problem with their base exchange water softeners. Suspended matter periodically fouled up the beds so that even after regeneration the exchangers functioned at low efficiency. In addition, tanks were corroded by the brine solution used for regeneration.

These problems were presented to the Hall field engineer in the area, and were licked when he prescribed Banox.* Both difficulties were taken care of by Banox, since it has an inhibiting action on brine corrosion, and its high activity as a dispersing agent assured clean beds each time the units were regenerated.

Other problems involving "dirty" exchangers can be solved once the facts are ascertained. Different solutions may be required, for example sterilization of the bed in a case of slime accumulation.

Paper Presented at Water Conference

B. Q. Welder, Hall engineer, presented a paper on "Gadgets" at the final session of the Fourteenth Annual Water Conference of the Engineers Society of Western Pennsylvania held in Pittsburgh on October 19, 20, 21. Co-authored by Dr. E. P. Partridge, Director of Hall Laboratories, the paper reports field observation of the performance of various devices claimed to be effective in treating water by non-chemical means. Reprints of the paper will be available after the "Proceedings of the Fourteenth Annual Water Conference" has been published.

*Banox is a registered trademark.

Stream Polution Survey Cuts Waste Disposal Costs

In order to comply with state standards, a metal-plating plant in the midwest was contemplating the construction of a waste water installation with a capacity of 1,500,000 gpd.

A detailed study of the processes employed in the plant, conducted by Hall engineers in close co-operation with plant personnel, resulted in recommendations leading to a drastic reduction in the amount of waste requiring treatment. The practical outcome—a waste water treatment plant is being built with a capacity of only 250,000 gpd, now adequate for all requirements. Additional benefits are being realized through more efficient operation and the recovery and reuse of plating materials.

The solution of the problem of waste water disposal began with a study of process water use and the development of methods for its conservation and reuse. Since this plant had time to act before the state authorities put the pressure on, a complete study was made to supply an economical and effective result.

Technical Information Program Covers 20 Years

Keeping clients informed is one of the continuing services of Hall Laboratories. During the past twenty years, reprints of nearly one hundred technical articles, papers and discussions have been sent to Hall clients all over the world. These reprints covered the latest developments in water treatment and allied fields, and ranged in subject matter from "Gaging and Sampling Water-Borne Industrial Wastes" to "Concentrating Films: Their Role in Boiler Scale and Corrosion Problems."

Some papers have been of such general interest that requests have come from many plants, not clients of Hall Laboratories, both in this country and abroad. For example requests for the paper on "Concentrating Films" have come from Canada, Venezuela, Argentina, England, Holland, India, Formosa, and the Philippines.

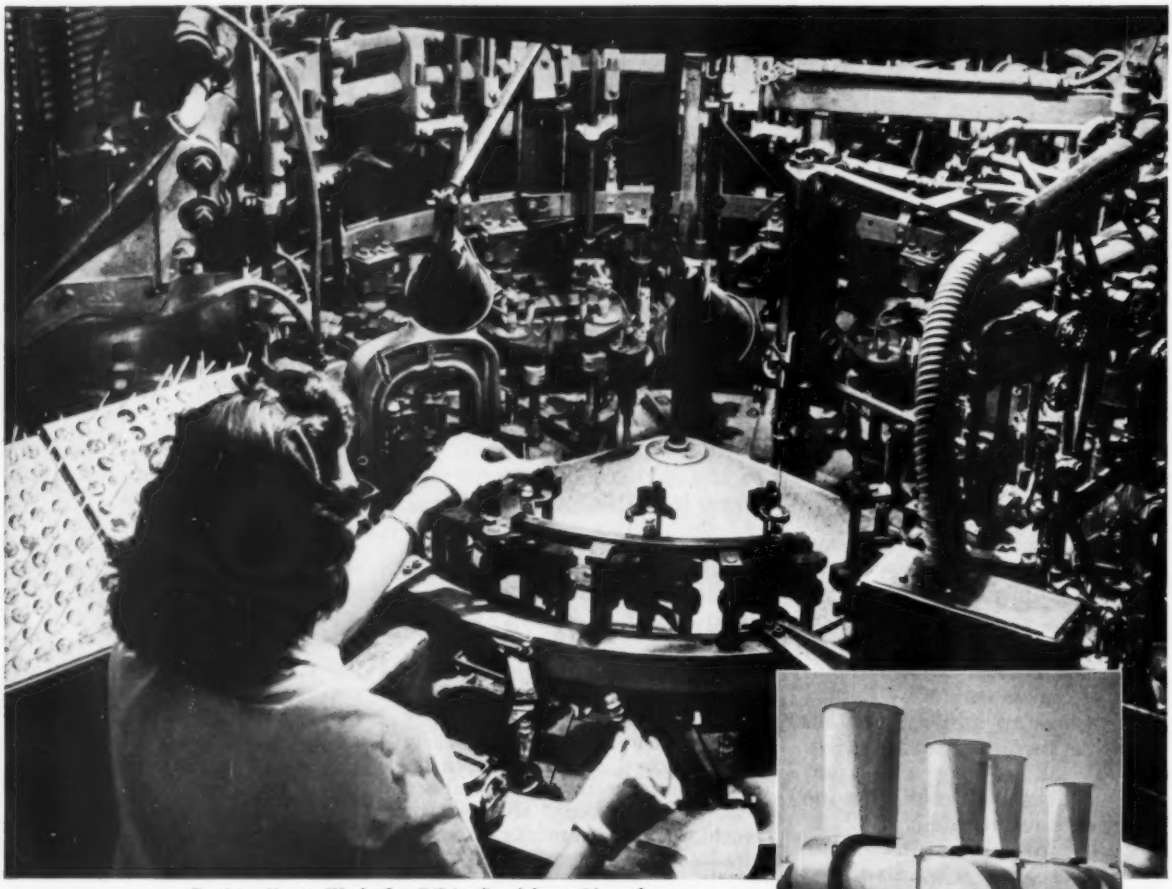
Industrial Water Problems Require Special Handling

There are no "stock answers" to industrial water problems. For information, write, wire or call Hall Laboratories, Inc., Hagan Building, Pittsburgh 30, Pa.

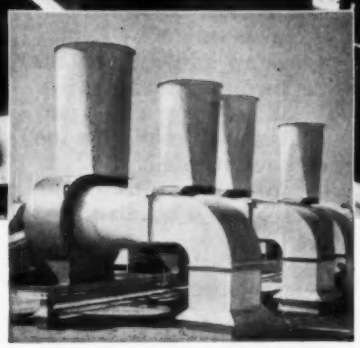
Water is your industry's most important raw material. Don't waste it.

ASME Meeting in New York

Among papers to be presented at the 74th annual meeting of the ASME in New York are several sponsored by the Joint Research Committee on Boiler Feedwater Studies. Included is the paper, "Action of Boiler Water on Steel—Attack by Bonded Oxygen" by Kaufman, Trautman and Schnarrenberger of Hall Laboratories. Other papers cover corrosion by dissolved oxygen and the breakdown of amines in boiler water.



Putting Air to Work for RCA: Special machines for mass production each create 112,750 BTU's, cause special problems.



Ten Westinghouse fans exhaust the intense heat caused by flame jets and induction heating. This highly efficient Silentvane® fan does the job well, requires little maintenance.

Installed by Kirk & Blum Manufacturing Co., Cincinnati. Consulting Engineer: Paul P. Kopf, Philadelphia.

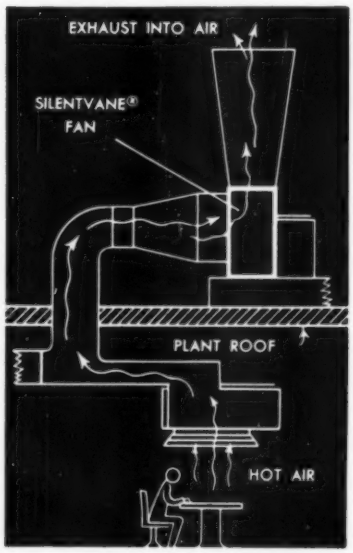
2,900,000 BTU EXHAUSTED

—OPERATORS STAY AT PEAK EFFICIENCY

Turning out miniature electron tubes is a hot business at RCA. Using a gas flame and induction heating, the process develops 2,931,200 BTU every hour. Exhausting this heat permits operators to work at peak efficiency.

Dependable Westinghouse fans handle the heat removal. They're rugged, can easily take the intense heat. And they do it quietly, efficiently.

If *you* have a heat exhausting requirement, or need ventilation for any purpose, let us help you. Westinghouse makes the most complete line of air handling, air conditioning and electronic air cleaning products available. Call your Westinghouse-Sturtevant office, or write: Westinghouse Electric Corporation, Sturtevant Division, Hyde Park, Boston 36, Massachusetts.



WESTINGHOUSE AIR HANDLING

YOU CAN BE SURE...IF IT'S **Westinghouse**

J-80297

For more facts circle 515 on Reply Card

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Your choice for strong, leakproof piping!

This TUBE-TURN Concentric Reducer is designed with the smoothest reductions and the strongest knuckle contours consistent with adequate tangent lengths and the end-to-end dimensions established for this type fitting by the American Standard. TUBE-TURN Reducers are superior to the pipe in bursting strength and their fatigue life equals that of the butt weld used to join them to the pipe.

For piping installations that are maintenance-free and have extra long life, specify TUBE-TURN Welding Fittings and Flanges. Your nearby TUBE TURNS' Distributor is at your service with industry's most complete line.

The Leading Manufacturer of Welding Fittings and Flanges

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ENGINEERING SERVICE

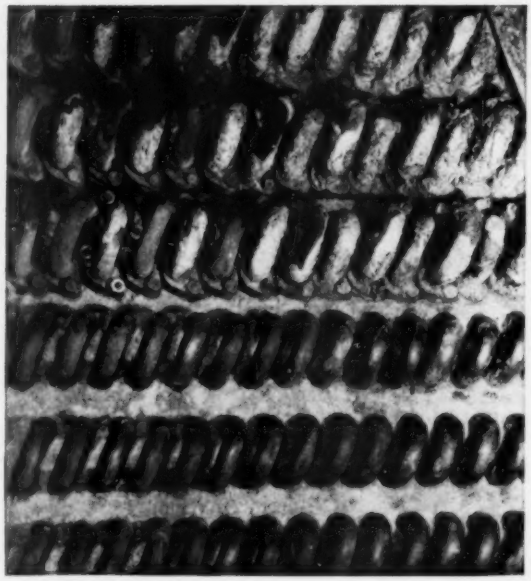
TUBE TURNS' *Engineering Service*

shows the way to eliminate equipment shutdowns

● In the past, directional changes in the tubes used in fuel economizers for boilers have been made with flanged U-bends or with header boxes. Although leakage was inevitable sooner or later, and repairs difficult, such conventional connections were necessary to permit periodic dismantling and mechanical cleaning.

Now, improved methods of water treatment have eliminated the need for such cleaning in most cases, and with it, the need for joints that can be readily disassembled. Accordingly, TUBE TURNS' Engineering Service has recommended re-fabricating tube assemblies with TUBE-TURN 180° Welding Returns, which are available in thicknesses and radii to match the tube walls and centers of most economizers.

The result has been the elimination of any leakage in economizer tubing, thus ending shutdowns of economizers, boilers, and other critical equipment. In addition, pressure drop is reduced, and flow conditions improved. When you have a tough piping problem, bring it to TUBE TURNS' Engineering Service—a service that typifies TUBE TURNS' leadership in piping engineering.



At top: flanged connections in economizer. *At bottom:* permanently leakproof, TUBE-TURN Welding Returns.

Shop fabrication of welded piping assemblies is easy, thanks to the uniform wall thickness and dimensional accuracy of TUBE-TURN Welding Fittings. Line-up is fast and accurate.

Want Piping Information?

Tube Turns, Inc. has prepared a booklet listing properties and specifications of pipe and fitting materials—carbon steels and wrought iron; stainless steels; nickel and nickel alloys; etc. For a free copy just send this coupon.

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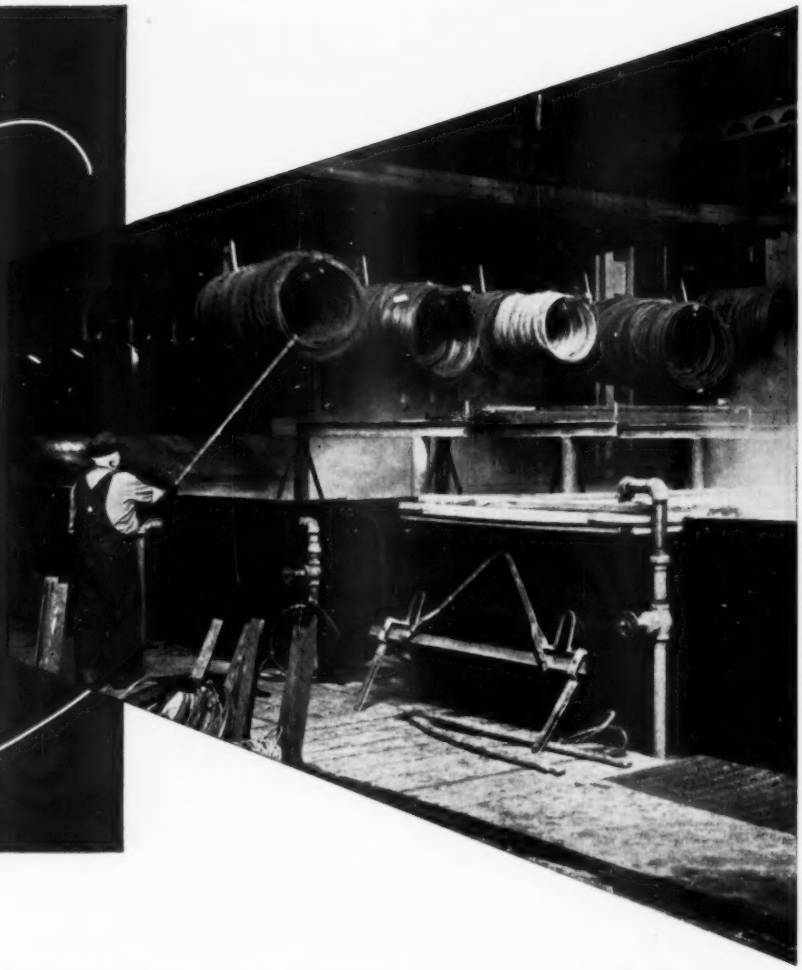
"tt" and "TUBE-TURN" Reg. U.S.Pat. Off.

TUBE TURNS, INC.

LOUISVILLE 1, KENTUCKY

Do You Have a Corrosion Problem as Tough as This?



If you have a tough corrosion problem, there's a good chance you'll find the solution in durable Pitt Chem Tar Base Coatings.

Pickling tank surfaces like these, for example, *really* take a beating from constant exposures to acid spillage, fumes, and condensation. But month in and month out, Pitt Chem Tar Base Coatings can provide economical, long-lasting protection against these and similar extreme corrosive conditions.

Pitt Chem Tar Base Coatings are easy to apply and up to ten times as thick as ordinary paints. No other material does such a complete job of protection at so little cost.

Why not drop us a line, *right now,* outlining your problem? We'll gladly provide you with our recommendations . . . or supply the technical literature or assistance you need.

W&D 4485

PITT CHEM 101—For Severest Conditions
PITT CHEM 102—Maintenance Coating
PITT CHEM 103—General Purpose Coating
PITT CHEM 104—Potable Water Service
PITT CHEM 105 AQUATAR—A Water Dispersion
PITT CHEM 106 TARMASTIC—Sealing Compound
PITT CHEM 107 PACHKOTE—Specialty Coating
PITT CHEM 110—Specialty Coating

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COKE & CHEMICAL CO.

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"THIS LUBRICANT EXTENDED BEARING LIFE 50%"

—says REPUBLIC AVIATION CORP.
Makers of the famous F-84E THUNDERJET

"Under actual tests, LUBRIPLATE extended bearing life fifty per cent or better as compared to other lubricants. It was also found that, during test, LUBRIPLATE increased efficiency of machines twenty per cent by reducing friction loss. Republic has been using LUBRIPLATE successfully for the past eight years."

For nearest LUBRIPLATE distributor, see Classified Telephone Directory. Send for free 56-page "LUBRIPLATE DATA BOOK"... a valuable treatise on lubrication. Write LUBRIPLATE DIVISION, Fiske Brothers Refining Co., Newark 5, N. J. or Toledo 5, Ohio.

REGARDLESS OF THE SIZE AND TYPE OF YOUR MACHINERY, LUBRIPLATE LUBRICANTS WILL IMPROVE ITS OPERATION AND REDUCE MAINTENANCE COSTS.

For more facts circle 518 on Reply Card

BACKTALK about our past issues

Edited by R. L. Marinello

Economics of Materials Handling

PLANT ENGINEERING:

"As a member of the Industry Service Committee of the Materials Handling Institute, may I congratulate you upon doing an excellent editorial presentation of the MHI Management Conference which was held in Detroit on September 17.

"Frankly, I think you have probably outjumped all of your competition. It will be very surprising to me if even the Materials Handling publications get this story into their books in October.

"Your coverage and presentation were indeed capably handled and I want you to know that both as a member of the MHI and as an individual in a company manufacturing products for the Materials Handling Industry, we think you have done a swell job." *J. E. Borendame, Manager of Sales Promotion, Acme Steel Co., Chicago, Illinois.*

Would Like More Info on Lighting Maintenance Companies

PLANT ENGINEERING:

"We read with great interest the article, starting on page 89 of the August, 1953 issue of your magazine. The article was by Leonard V. James, titled 'Maintenance Costs of Industrial Lighting Systems.'

"In this article, Mr. James mentions the organization by contractors of the 'Associated Lighting Maintenance Companies of America' and their plan of contracting to install, rent and maintain an installation.

"We would appreciate more information on this subject and ask that if possible, you give us the best sources from whom we can obtain data on the subject." *L. T. Kratz, Taylor Fibre Company, Norristown, Pennsylvania.*

▶ As to more information about the organization of contractors for maintaining lighting equipment, we would suggest that you write to Edward I. Creed, C & S Lighting Maintenance Co., 6116½ St. Clair Ave., Cleveland 3, Ohio. Mr. Creed is secretary of the Associated Lighting Maintenance Companies of America and will be in the best position to give you information about the group.—*Editors*

Inquires About Lift Units For Cleaning Light Fixtures

PLANT ENGINEERING:

"The article in your August issue, entitled 'Maintenance Costs of Industrial Lighting Systems,' brings a number of questions to my mind. The article states that lighting maintenance contractors are now available in many industrial centers. Should you have a list of these contractors located in the middle west, I would appreciate a copy. It also states that there is an organized group known as the Associated Lighting Maintenance Companies of America. Could you supply the address to be contacted?

"We are now starting on a maintenance program of lighting fixtures where a large majority of the fixtures are mounted approximately 30 ft from the floor. It might be stated that we are a fabricator of sheet metal products, therefore, we do have large equipment such as presses, baking ovens, etc., which obstruct a direct path from the floor to the fixtures. During the construction of the buildings, apparently no particular consideration was given to a simplified method of lamp replacement and fixture cleaning.

"Our present thinking leads us to believe that a mobile lift unit would offer the most economical method of fixture replacement and cleaning. To date, we have not been able to find a lift unit suitable for this job. Should you have any suggestions to offer, be assured they will be appreciated." *Ross P. Webster, Planning and Scheduling Analyst, General Electric Co., Louisville, Kentucky.*

▶ As mentioned above, Mr. Creed will be able to supply you with a listing of contractors for the middle west as well as more information about the organization. As to mobile lift units for fixture replacement and cleaning, we would suggest that you contact Barrett-Cravens Co., 4613 South Western Blvd., Chicago, Illinois. Another company which may be of help to you is Economy Engineering Co., 4501 West Lake St., Chicago 24, Illinois.—*Editors*

Apologies to Mr. KirkHAM

PLANT ENGINEERING:

"In case you wondered, the F. G. Kirk*man* who is credited on page 80 of the October issue with being the author of the article 'Intra-Plant Phone Sound Systems' is in reality F. G. Kirk*ham*. This is not the first time it has been so misspelled nor will it be the last." *F. G. Kirkham, Eastman Kodak Co., Rochester, New York.*

▶ The one rule in this business that no one ever breaks is the one that says a man's name must be correct. However, it was badly bent this time. We are very sorry this happened. Each member of the editorial staff has been requested to have his eyes examined before proofreading any more galleys.—*Editors.*

Zeprex to Sweden and Back

PLANT ENGINEERING:

"In the April edition I saw an article about Zeprex. A friend, who recently visited Sweden, has been enthusiastic about building materials used there, such as Zeprex.

"Will you please send me any information that you might have on this material?"—*Del Ericson, General Contractor, Moline, Illinois.*

Pipe Insulation Queries

PLANT ENGINEERING:

"We are very much interested in receiving complete information on G-B Ultrafine Pipe Insulation, described in the June issue.

"Full descriptive literature, together

In electrical installations *where QUALITY counts* use CONDULETS*

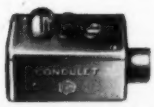
Quality does count in practically every electrical conduit installation that you make. When you use CONDULETS you know that you are putting in electrical equipment of the highest quality, because CONDULETS have been doubly tested . . . in the factory and in the field.

Crouse-Hinds quality control assures a long-lasting product and field records prove it by the test that only time can give. Thousands of CONDULET installations are still in tip-top condition after twenty, thirty, or even more than forty years of dependable service.

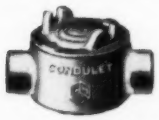
The illustration at the right shows four of Crouse-Hinds' basic quality features that are common to all CONDULETS. The fifth, Wedge Nut Fasteners, is an exclusive Crouse-Hinds feature that has made Obround CONDULETS preferred by electricians everywhere.

Type EVA Explosion-Proof Lighting Fixture

Type ARE Arktite Receptacle Equipment



Type FS Condulet With Pilot Lamp Receptacle, Switch and Plug Receptacle



Type GUAC Explosion-Proof Junction Condulet

1. **Taper tapping.** Condulet threads are taper tapped to match tapered conduit threading. Makes a rigid joint that will not loosen. This assures permanent ground continuity . . . important for safety.
2. **Integral bushing.** A smooth rounded surface protects wire insulation.
3. **Material.** Feraloy . . . a special alloy that is strong and tough, resists corrosion, and gives sharp, full threads
4. **Finish.** A triple treatment provides long-lasting protection . . . exceeds Federal and U. L. specifications.
5. **Wedge Nut cover fastener.** Clear cover opening . . . no projections. No loose parts . . . Wedge Nuts and screws self-retained. No screw holes to align.

More than 15000 items are listed in the Condulet Catalog including a complete explosion-proof and dust-tight line for use in hazardous locations.

On your next job, use CONDULETS . . . they're made right to last longer.

**CONDULET is a coined word registered in the U. S. Patent Office. It designates a product made only by the Crouse-Hinds Company.*

Type VC Vaportight Industrial Lighting Fixture

Type FLB Explosion-Proof Circuit Breaker Condulet

Type EPC Explosion-Proof Motor Starter and Circuit Breaker Condulet

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MODERN PLANTS HAVE
MODERN SKYLIGHTS OF
SHATTERPROOF

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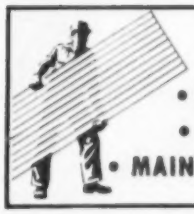
TRANSLUCENT
STRUCTURAL PANELS



WHY?
• LOWEST COST
• BETTER LIGHT
• MAINTENANCE FREE

Skylights of Resolite are installed at half the cost of conventional glazing because Resolite nests with all standard corrugations; requires no framing or flashing. It rests on the same members, is fastened the same way as the metal sheets. Sidewall lights of Resolite in non-corrugated construction need no expensive sash, simple angle girts give full support.

Shatterproof, structurally rugged, inert to usual industrial fumes, Resolite has unlimited life without protective treatment or maintenance. It is a quality product composed of stable polyester resins, reinforced with a *two-ounce* Fiberglas mat. It can be sawed, nailed, bolted and installed with ordinary tools by unskilled workers.

Flat sheets for sash are factory-cut to size. They are installed like glass.

The pictures above show the even distribution of daylight obtained in a building skylighted and glazed with Resolite. Its diffused light gives workers greater visual comfort . . . cuts artificial light costs. See why more and more nationally known industries are using Resolite for modern plant daylighting.

Send for New Industrial Skylighting Folder and Name of Nearest Distributor

RESOLITE CORP.
BOX 517 ZELIENOPLE, PA.

For more facts circle 520 on Reply Card

BACKTALK

with reference to sizes available, should be forwarded to the attention of the writer." *Paul H. Beier, Plant Engineer, Austenal Laboratories, Inc., New York.*

PLANT ENGINEERING:
"We would like very much to obtain additional information regarding G-B Ultrafine Pipe Insulation, as mentioned in a recent issue of your magazine." *Frank A. Bundy, Purchasing Agent, Chicago Telephone Supply Corp., Elkhart, Indiana.*

PLANT ENGINEERING:
"Your June issue has an item on 'Pipe Insulation Snaps into Service.' It describes the merits of G-B Ultrafine fiber glass pipe insulation.
"We would be pleased to receive additional information such as advertising pamphlets, approximate cost of the various sizes, etc." *F. C. Halpin, Chief Engineer, The Texas Co., Lockport, Illinois.*

Letter from Manufacturer Of This Pipe Insulation

PLANT ENGINEERING:
"We want to thank you for your treatment of our unusual new pipe insulation.
"As to the quantity and quality of inquiries we have received from this publicity—it is what we consider as most unusual. You can be assured that we are following through promptly." *B. P. Murphy, Director of Advertising, Gustin-Bacon Manufacturing Company, Kansas City, Missouri.*

No Charge to Our Friends

PLANT ENGINEERING:
"Several months ago, in an issue of PLANT ENGINEERING, there appeared an article "Putting the Finger on Maintenance Costs." This number system was in use by an aircraft manufacturing concern on the West Coast. If possible, I would like tear sheets of this article.
"May I also offer my appreciation for PLANT ENGINEERING. It is most interesting and invariably I clip an article or two from each issue for future reference. Of particular interest to me, in the last two issues, were the stories on engineering projects at Thew Shovel Co. Please bill me for the cost of the tear sheets." *W. F. Moore, The Cleveland Welding Co., Cleveland, Ohio.*

▶ Sorry, but we can't charge our friends; and as in the story—We don't have an enemy in the world.—*Editors.*

Ruling on Yeast Plant

PLANT ENGINEERING:
"The article 'Court Decisions,' page 70 of the October, 1953 issue, reported a decision on operation of yeast drying plant wherein the Supreme Court of Wisconsin held that such operation was not a violation under the ordinance against nuisance.
"We shall appreciate if it you could furnish the citation on that case to our attorney. We know that it would be asking too much to quote the decision because it is probably lengthy, but please furnish the citation in order that our attorney may brief the case." *Dwight L. McCormack, attorney for Valcar Enterprises, Inc., Dallas, Texas.*

▶ We agree with you that it probably is a lengthy decision and are passing the court reference on to you so that you can brief the complete court ruling on this ordinance.—*Editors.*

Seeks Info on Anchor Bolts

PLANT ENGINEERING:
"Around our plant we frequently attach pipe hangers, heater hangers, etc. in reinforced concrete ceilings. For this purpose we star-drill a hole and use expandable lead plug-studs to attach a stud to the ceiling or wall.
"Could you give us a lead on the correct nomenclature, manufacturers, and design data for choosing the right size and number of such plug-studs to support various known loads?" *Edwin Haftings, Engineering Department, W. H. Barber Co., Minneapolis, Minnesota.*

▶ We should like to suggest that you write directly to Holub Industries, Inc., Sycamore, Illinois, and Ideal Industries, also in Sycamore, Illinois. Both of these companies make various types of anchor bolts and should be able to supply you with additional data on the proper sizes for various loads.—*Editors.*

Interested in Glass Lining For Boiler Air Heaters

PLANT ENGINEERING:
"On page 116 of your July, 1953 issue, I note announcement of a new ceramic steel fusion of glass to steel pioneered recently by the A. O. Smith Corp.
"I am interested in possible fusion of glass to steel for boiler air heaters. Can you tell we whom I could contact to get some information on this subject?" *E. B. Plapp, Assistant Chief Engineer, American Smelting and Refining Co., El Paso.*

▶ Your letter has been forwarded to J. A. Duvall, Advertising Manager of A. O. Smith Corp., Milwaukee, Wisconsin.—*Editors.*

To Reprint Leather Belt Article

PLANT ENGINEERING:
"Could I have permission to reproduce in a future issue of *P. T. C. Bulletin* the article appearing on page 112 of the September, 1953 issue, entitled 'Flat Leather Belts, Tension Bases, Are Versatile Power Transmission Twins?'" *E. R. Rath, Vice President, Power Transmission Council, Inc., New York.*

▶ We are very happy to grant you permission to reproduce this article.—*Editors.*

so an Ostrich can take it . . .

. . . maybe your processing equipment is a little less hardy than the proverbially tough digestive mechanism of this odd bird.

Bits of iron—nails, wire, crushed tin, nuts and bolts—are a headache, sometimes a serious hazard, to a lot of food, chemical, and other processors. Many have successfully relied on Dings Magnets to solve their problem.

Dings makes a complete line of electric and non-electric magnets for installation in, on or above material conveying systems and integration with processing machinery. They can save you plenty of trouble. Learn about them by just mailing the coupon below.

Here's Just One Way — Dings Magnetic Pulleys — both electro and Alnico permanent — are at work in all kinds of industries pulling unwanted iron out of everything from grain and cotton to coal and molybdenum ore.

Dings

DINGS MAGNETIC SEPARATOR COMPANY

4766 W. Electric Ave. Milwaukee 46, Wis.

Please send me a copy of Catalog C-5000-B

Name..... Title.....

Firm .....

Address .....

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NEXT TIME...ORDER SCOTTISSUE TOWELS!

1. They drink up water like an Airedale in August.
2. They're strong — even when soaking wet.
3. They're so soft that many people use them as face cloths.
4. They're clean and white — of course.
5. They're double-fold to dry double-quick.

EVER PLAY "GUESS THE WEIGHT"?

ScotTissue Towels have an exceptionally high fiber content. This "bulk," plus generous size and double fold, makes a case of 3,750 ScotTissue Towels weigh 46 lbs.* Some paper towels cost less for 3,750 but are 10 to 20 lbs. lighter*— hence less drying power. Write for more facts. Scott Paper Company, Dept. **PE-4**, Chester, Pa.

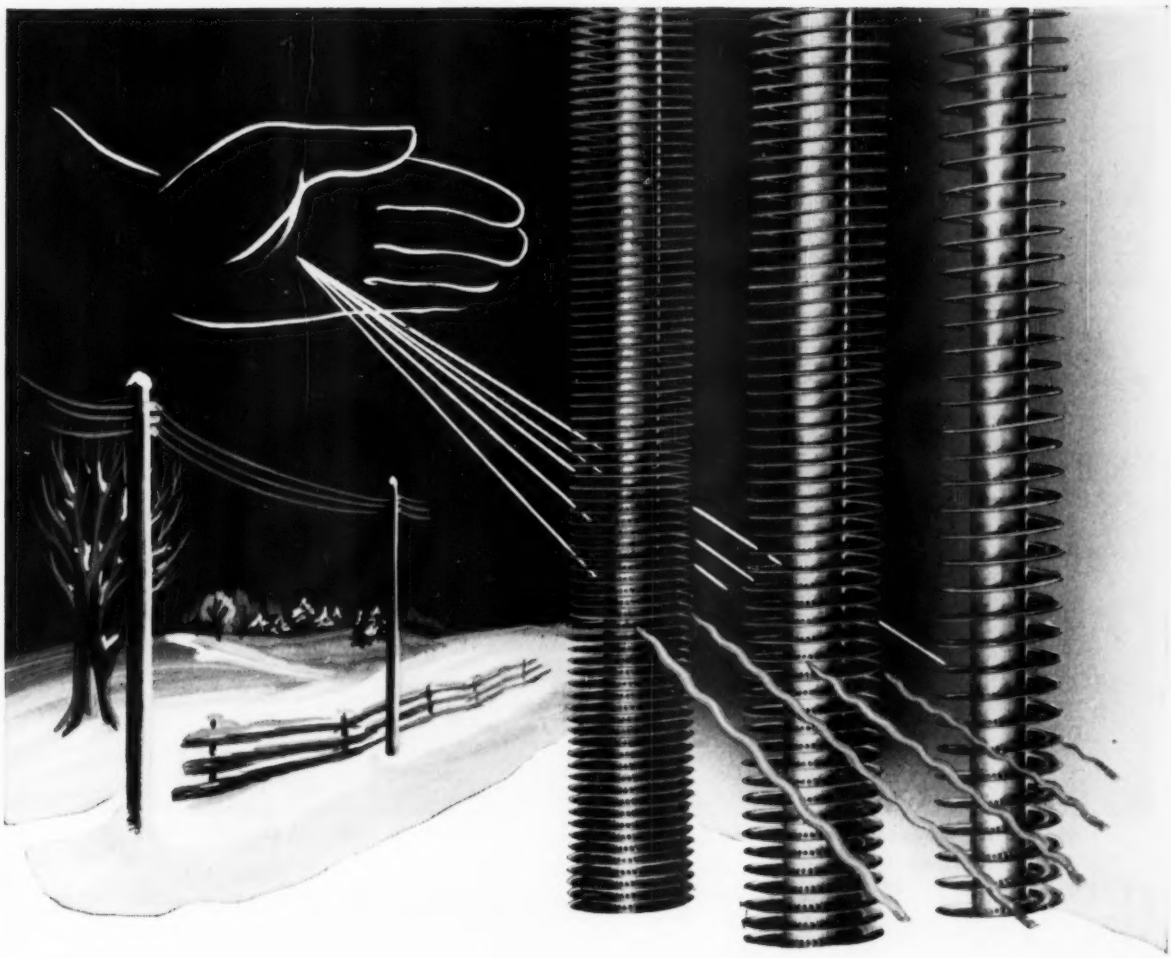
*Shipping weight

SCOTTISSUE **TOWELS**

Symbol of the right kind of washroom

"ScotTissue," Reg. U. S. Pat. Off.

For more facts circle 522 on Reply Card

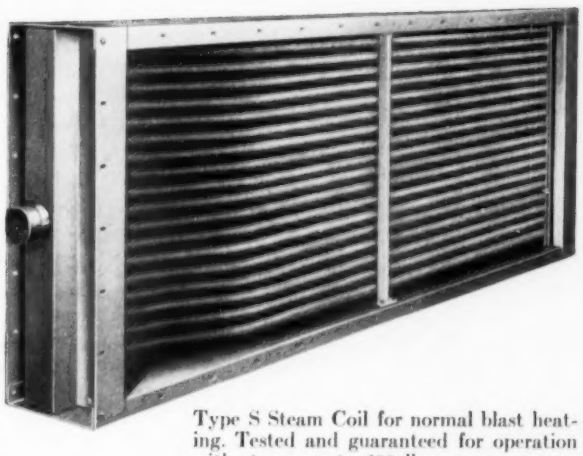


Check winter's icy hand with American Blower Heating Coils

They're quality-built. All tubing is helically wound with copper or aluminum fins in three standard spacings (see above). Coil casings are made of heavy galvanized steel; headers are of die-formed steel.

Whether you need coils for blast heating, zone reheating or whether you want return bend coils or coils for modulated steam control—you'll find the size and type that best fits your needs in the American Blower line. Write for further data.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation



Type S Steam Coil for normal blast heating. Tested and guaranteed for operation with steam up to 200 lbs. gauge pressure and 450° F temperature. Die-formed tube support protects tubes. Write for Bulletin B-1218.

AMERICAN BLOWER

YOUR BEST BUY IN AIR HANDLING EQUIPMENT

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS

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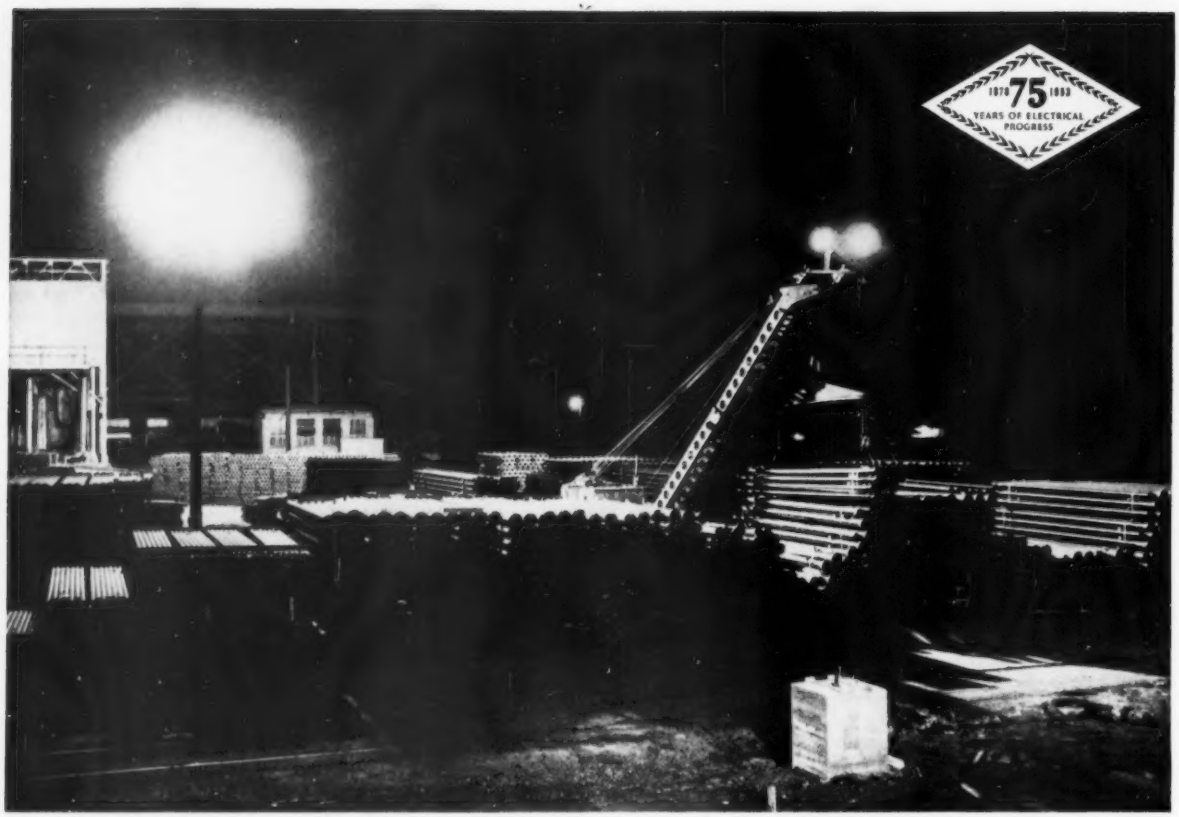


USED 10 HOURS A DAY, G-E L-69 FLOODLIGHTS DOUBLE USEFULNESS OF OUTDOOR STORAGE AREA.

G-E Floodlighting in company's storage yard makes possible two-shift materials handling

A LIGHT FOR EVERY NEED is available from G.E.'s full line: **A** High efficiency, lightweight, easy-to-install area floodlight for crossarm mounting, available in any of three beam spreads; **B** Heavy-duty, wide variety of mountings, and beam spreads; **C** Inexpensive, open floodlight for closer-range illumination.

"In our plant, two-shift operation would have been impossible without outdoor materials handling at night. We installed G-E L-69 floodlights in our outdoor storage area, and used them 8 to 10 hours a day to keep our materials moving in and out of our factory," says A. J. Fruchtl, plant manager at U. S. Pipe & Foundry Company's North Birmingham Works.

You can double the usefulness of your outdoor areas with G-E Floodlighting. And good floodlighting means good working conditions, fewer accidents, less pilferage. You'll find that an investment in adequate G-E outdoor lighting will pay for itself over and over again.

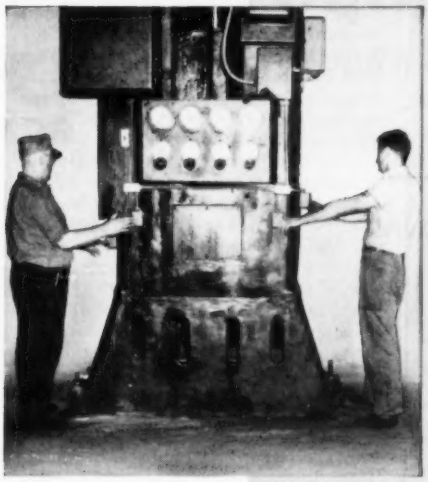
Whatever your outdoor lighting needs, G.E. has a complete range of industrial lighting equipment to exactly suit your requirements. Call your local G.E. Sales Office or authorized distributor for advice on good lighting at your plant. Or write for "Outdoor Lighting for Industrial Plants." Just ask for GEA-3640. Address Section 451-186. General Electric Company, Schenectady 5, N. Y.

You can put your confidence in—

GENERAL ELECTRIC

For more facts circle 524 on Reply Card

Two-hand **MICRO** trip control on punch press. It is controlled by feather-touch actuation of both switches at the same time.



MICRO trip and selector control. Requires actuation of four hand switches by the two operators. Can be set for operation by one to four switches.

MICRO trip provides automatic cycling control on huge paper cutter. Operator holds two switches until cut is made.

MICRO trip users report up to 20% increased production from power presses—with *SAFETY*

• MICRO trip electrical clutch controls provide instantaneous electrical response. Their light-touch actuation reduces operator fatigue. They permit operators of punch presses, power shears, hydraulic presses and other power machines to work with complete freedom from worry.

MICRO trip cannot be "cheated." It is a two-handed tripping device so designed as to prevent tying, wedging or otherwise securing one switch so as to operate with one hand only. Any component failure automatically breaks the clutch operating circuit. It affords complete protection to machine operators and set up men.

MICRO trip also may be used with single switch control in circumstances where one hand is otherwise occupied. It is also ideal for multiple operator installation. Electrical signal systems can be tied in with MICRO trip. MICRO trip permits single stroke control for positive mechanical clutch machines and automatic cycling control for hydraulic, pneumatic or friction clutch machines.

Send for MICRO trip catalog today. Write to MICRO, Freeport, Illinois, for name of distributor nearest you.

MICRO

MAKERS OF PRECISION SWITCHES

FREEPORT, ILLINOIS

HONEYWELL

A DIVISION OF

MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

For more facts circle 525 on Reply Card

PLANT ENGINEERS' DIGEST so those who rush may read and know what's new

Edited by E. B. Skubik

Fly Ash Concrete

ONE OF THE MOST pesky by-products of generating electricity may be on its way to becoming a useful product. Fly ash, long a scourge, is now being used constructively.

Mixed in exacting proportions into concrete, fly ash has become an integral part of the new 400,000 kw Kanawha River plant of the Appalachian Electric Power Co. at Glasgow, West Virginia. About 50,000 yd of fly ash concrete was used in the plant, believed to be the first time the process was used in the state.

Tests at various concrete laboratories have revealed the following major advantages of concrete containing fly ash: lower cost of materials; better finishing qualities; less permeability or passage of water; improved workability; slight reductions in strength up to 28 days, marked increase in strength after 28 days; less contraction and expansion and equal or better resistance to frost action.

There's a catch in the optimistic outlook for the use of fly ash, however, because only certain types of fly ash can be mixed with concrete. The fly ash must have certain predetermined fineness and chemical content.

Often there is a variation in chemical content of fly ash, occurring not only between generating stations but between units in a plant. There are several reasons that chemical content varies. The most important is the type of coal burned. Other reasons include furnace draft, the power load the plant is carrying and the efficiency of both the unit and the coal pulverizers.

But this dust-like powder, which only a few years ago was regarded as an unglamorous, useless waste material, is believed to be headed for a bright future in industry. Some day it may have such uses as filler material for plastics, rubber paints, prepared plasters, mortars, and bituminous road construction and so on. It also has been used successfully in oil well grouting and in the manufacture of concrete building blocks. *From an article in The Illuminator.*

Pump Trouble Diagnosis—Handy for Plant Engineer

POSSIBLE CAUSES	SYMPTOMS				
	NOISY	WEARING RAPIDLY	STARTS THEN LOSES PRIME	NOT UP TO CAPACITY	TAKES TOO MUCH POWER
Pump running dry	✓	✓			
Insufficient liquid supply	✓	✓		✓	
Liquid vaporizing in suction line	✓		✓	✓	
Grit or dirt in liquid		✓			
Liquid heavier or more viscous than specified for pump					✓
Air leaks in suction or stuffing box	✓		✓	✓	
Air or gas pockets in system			✓		
Suction pipe too small, too long, or has fittings to increase pipe friction abnormally and cause liquid to vaporize	✓			✓	
End of suction line not immersed deeply enough	✓		✓		
Suction lift too high, bubbles form to use up part of pump displacement	✓			✓	
Suction strainer clogged or of insufficient area	✓			✓	
Pump out of alignment	✓	✓			
Rotating elements bind and wear excessively	✓	✓			✓
Relief valve chatters because of improper seating or incorrect setting	✓			✓	
Pipe strain on pump casing	✓	✓			
Pump operating against excessive pressures		✓			✓
Corrosion roughening rubbing surfaces		✓			
Stuffing box packed too tightly					✓
Speed too low				✓	
Speed too high	✓				✓
Pump parts worn				✓	
Hand bypass or return line partly open				✓	
Obstruction in discharge line causes pump to operate above rated pressure	✓				✓

This chart offers a quick analysis of difficulties arising with rotary pumps. (From Power and Fluids, published by Worthington Corporation, Harrison, N.J.)

Illumination and Accidents

GOOD ILLUMINATION has long been recognized as a most important factor in industrial-accident prevention and for this reason progress in illuminating engineering has kept pace in the industries with the advance of general industrial science.

The number of accidents fairly attributable to inadequate and otherwise unsuitable illumination is still, however, far greater than is justified by our present knowledge of correct lighting principles and the means of applying them.

Although inadequate illumination is known to be a cause of accidents, the importance of adequate and satisfactory illumination is neither recognized nor appreciated to its full extent.

There are millions of violations of the fundamentals of good illumination in our workshops—violations that endanger all workers, regardless of the character of their vision; and millions of workers are laboring every day under the double handicap of poor lighting and subnormal eyesight.

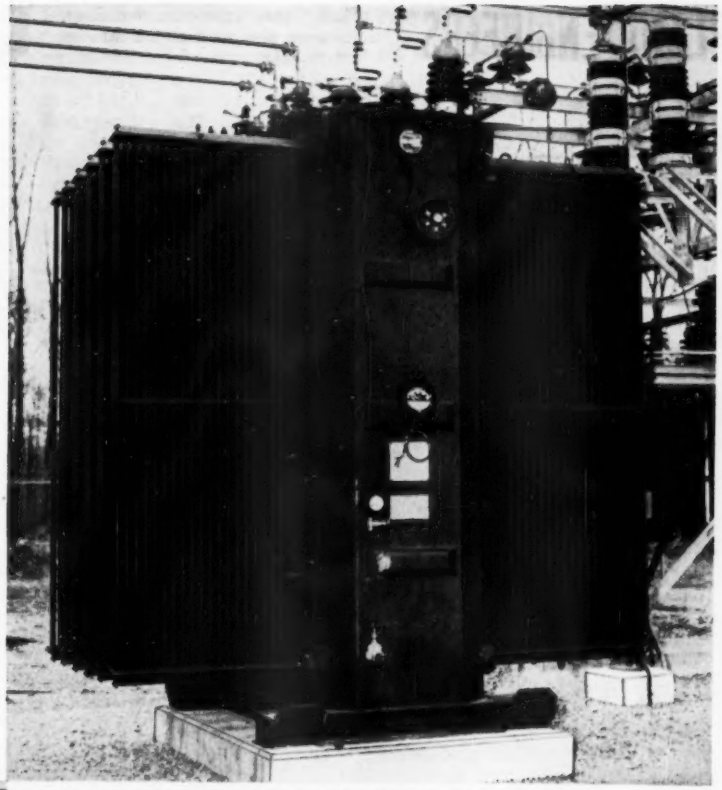
Accidents from improper or inadequate illumination occur in two ways: First, wherever there is a hazard and the illumination is insufficient to disclose it; second, improper illumination causes eyestrain and eventually brings about a defect in vision, with the result that the ability to see—a most important safeguard even when adequate illumination is provided—is greatly reduced.

Those who are intimately acquainted with plant operations know that lighting is customarily regarded as part of overhead expense. Decisions about it are frequently made by executives who want to make every penny count. It follows that many times an arbitrary decision to keep overhead down may fail to provide the lighting essential to safe, efficient plant operation.

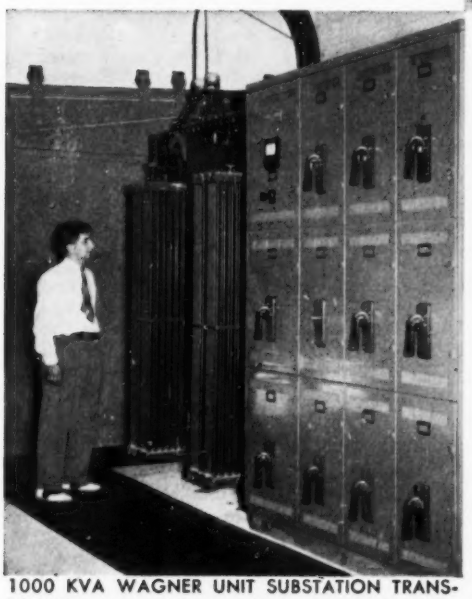
There is hope now in the new

Wagner

Transformers used by Studebaker in new power distribution system planned for present and future needs



6000 KVA WAGNER POWER TRANSFORMER where power is received at 26.4 kv and is stepped down to 13.2 kv for distribution to the seven unit substations in the plant.



1000 KVA WAGNER UNIT SUBSTATION TRANSFORMER, at one of the five load centers that deliver 440 volt, three phase power to large machines and equipment.

New Jersey plant can convert from military to auto assembly production without extensive system changes!

The modern power distribution system at the Studebaker Corporation plant at New Brunswick, New Jersey has been planned with an eye to the future. While the plant is now manufacturing military jet engine parts, it will eventually become eastern auto assembly headquarters for Studebaker.

The power load is divided between seven load center substations, all equipped with Wagner Unit Substation Transformers, spaced 160 feet apart down the center of the building. In addition to insuring an adequate power supply for present purposes, this plan provides a dependable supply of power from short secondary feeders at any time in the future.

* * *

Why not discuss your next transformer installation with the Wagner engineer nearest you? There are Wagner branches in 32 principal cities. Bulletin TU-181 gives full information on Wagner Power Transformers, and Bulletins TU-13 and TU-56 tell about Wagner Unit Substation Transformers. Write for your copies.

WAGNER ELECTRIC CORPORATION
6492 Plymouth Ave., St. Louis 14, Mo., U.S.A.

® Wagner Electric Corporation EST. WE 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

BRANCHES IN 32 PRINCIPAL CITIES

T53-9

For more facts circle 526 on Reply Card

PLANT ENGINEERS' DIGEST

(Digest begins on page 28)

methods for estimating the full bill for industrial accidents, in which every element for safe operation will be permitted to contribute fully.

As each company gets a more definite estimate of its casualty burden, it will find it easier to authorize larger appropriations for safety programs. As safety departments strive to improve operating conditions they are likely to get much sympathetic support from the plant engineers.

More knowledge about indirect consequences (and therefore costs) of accidents may lead to new attitudes about traditional ways of charging certain bills. *From an article by J. L. Tugman in Better Light Better Sight News, New York, N.Y.*

Standby Power Kept Salvage Going

AN OUTSTANDING demonstration of the usefulness to industry of standby electric power occurred recently at the ruins of the G M plant near Detroit, Michigan.

For salvage reasons, hundreds of machines were moved onto the extensive employee parking grounds as soon as workmen could enter what was left of the plant. But at the end of the first day, when darkness set in, practically all salvage operations necessarily came to a standstill.

Although main line power had already been made available, it was considered too dangerous to run current through under-pavement feed lines from the fire area until these lines could be examined and checked for damage.

Standby electric power units mobile enough to be set up at any point desired were answers to the problem. One of these was a truck-mounted 100 kw diesel unit which was hooked to the control panel of the parking lot lighting system.

Two of the standby units used in night salvage work appear in the foreground

Three other base-mounted diesel units were also used at the stricken plant to take care of lighting at a railroad siding inside the plant gates and at other critical points removed from the general parking area.

For over ten nights it was possible for salvaging operations to proceed without interruption under emergency lighting facilities. Thus through the use of the standby power units the Detroit transmission division gained valuable time in its effort to get back into production. *From a release for Detroit Diesel Engine Div., General Motors Corp., Detroit.*

Baffles Absorb Stamping Noise

THE NOISE and clamor from metal stamping machinery in the long Island plant of John Volkert Metal Stampings, Inc. has been reduced approximately 50 per cent by millions of minute fibers of glass. The noise reduction percentage has been measured accurately by engineers with tests taken over the entire audible frequency range before and after the baffles were installed.

Three hundred twenty baffles of fibrous glass were installed in a 5,000 sq ft area in the plant with the result that noise has been sliced in

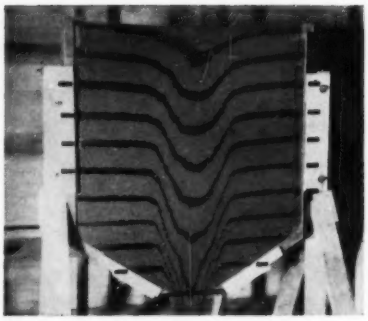
Baffles prevent some of the machine noise from bouncing back to work area

half and employees have a more pleasant place in which to work.

The panels absorb noises that normally would strike the unyielding surface of a ceiling and bounce back into the working area. The baffles are covered with a thin plastic film which transmits sound waves by diaphragmatic action into the tiny, dead air pockets between the fibers of glass. *From a release for Owens-Corning Fiberglas Corp., Toledo, O.*

Flow of Materials in Bins

FLOW of solid materials in chutes, bins and hoppers is currently being investigated at the research laboratories of the Richardson Scale Co. of Clifton, N. J. Before long, the company hopes to evolve a general equation for the flow of solids in any bin of symmetrical shape, which should be of considerable use to bin



Model bin section with glass window permits the observation of material flow

designers in simplifying their work.

Engineers know a lot about how liquids behave in motion, but little about the characteristics of solids in flow. Significantly, there is not much known about the flow of solids in bins and similar vessels. Information is largely restricted to a few materials in large cylindrical silos, the flow of earth in dams and retaining walls, and occasional data on some materials in a few types of bin configurations.

So far, research engineers at the lab have collected considerable information on the pressure exerted by different materials on the bin discharge opening. They have also collected much on the lateral and vertical pressures existing at different points within the material mass.

To test equations and theories evolved, the solids-flow laboratory is equipped with a hydraulic load cell and a series of varying bin sections. With the arrangement, engineers are able to closely study the relationship between various heights of material in a bin and the pressures at the discharge opening.

One piece of original equipment built for the lab is a machine called a K-determinator. With the machine, it is possible to evaluate the relation between lateral and vertical pressure for various materials under load conditions in a bin. *From a release for Richardson Scale Co., Clifton, N. J.*

Battery Wire Connector Repairs

INDUSTRIAL BATTERY plugs and receptacles, although of rugged design, are not indestructible and can be damaged by misuse. Foreign material such as water, grease, oil, dirt, and so forth in the receptacle will make it useless unless it is repaired.

In repairing a damaged or dirty plug or receptacle connected to a battery, the user must not forget that the leads which terminate in the receptacle are live or "hot" with the total voltage of the battery existing across the terminals.

Before removing the terminal lugs from the receptacle, the battery circuit must be opened or broken. If this is not done and the terminal

...with TYCOL lubricants on hand!

The "All-Weather" Bearing Lubricant! Steel mills have shown a lively interest in Tycol Acylkup 4, a year 'round bearing grease that does a variety of jobs with a complete disregard for thermometer readings. Although all methods of application are suitable, one "3-Furnace" mill has found it particularly adaptable for use in its automatic grease systems – with complete ease of pumping even in the coldest weather. From Blast furnaces: Sheave Bearings, Bell Mechanism, Skip Hoists, etc. . . . to Coal and Ore Bridges, Tycol Acylkup 4 is a natural for lubricating yard equipment in every steel mill. With two big savings: "all weather" protection . . . and lowered maintenance costs on automatic pressure systems. For details, contact your local Tide Water Associated office!

TYCOL
INDUSTRIAL LUBRICANTS

Boston • Charlotte, N. C. • Pittsburgh
Philadelphia • Chicago • Detroit
Tulsa • Cleveland • San Francisco
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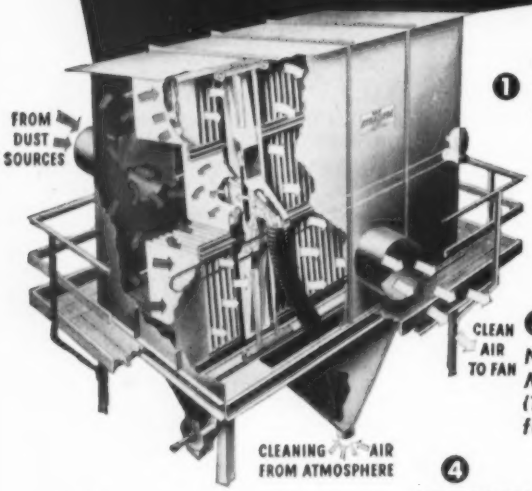
Over 300 Tycol industrial lubricants are at your disposal . . . engineered to fit the job!

TIDE WATER ASSOCIATED OIL COMPANY
17 BATTERY PLACE · NEW YORK 4, N.Y.

REFINERS AND MARKETERS OF VEEDOL . . . THE WORLD'S MOST FAMOUS MOTOR OIL

For more facts circle 527 on Reply Card

THE
DYNACLONE®
PATENTED
The ULTIMATE in Dust Filters



1 CONSTANT SUCTION at dust sources.

2 SELF CLEANING for continuous operation.

3 NO AUXILIARY MOTORS or BLOWERS (The main operating fan does the cleaning).

4 NO ABRASION of BAGS by the CLEANER.

5 LESS OVERALL HEIGHT and FLOOR SPACE.

HOW IT OPERATES

(a) Dust laden air is drawn in from the dust sources as indicated by the shaded arrows.

(b) It is diffused into the dust chamber by the baffle plate.

(c) It is then drawn through the fabric of the filter bags and is cleaned as shown by the clear arrows.

(d) Clean air passes out of the case and goes to the suction fan.

(e) Concurrently, the traveler moves back and forth across the dust wall registering successively with one bag at a time.

(f) The suction which exists in the dust chamber draws a blast of atmosphereic air through the bag in reverse directions and cleans that bag. (No shaking.)

Control your industrial dust better, for less — with the Sly Dynaclone. May we explain how?

SEND FOR BULLETIN NO. 102

THE W. W. SLY MANUFACTURING CO.
4600 TRAIN AVENUE • CLEVELAND 2, OHIO
New York • Chicago • Philadelphia • Syracuse • Detroit • Buffalo
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SLY PIONEERS & LEADERS in INDUSTRIAL DUST CONTROL

For more facts circle 528 on Reply Card

PLANT ENGINEERS' DIGEST

(Digest begins on page 28)

lugs are accidentally touched together, a short circuit and arcing will occur which can injure personnel and equipment.

The strength of the arc will depend on the size of the battery. The amperage carried may reach 10,000 amperes and may exceed the current carrying capacity of the leads. The short circuit rate will equal three times the one minute discharge rate of the battery.

To open the circuit, either disconnect one lead from the battery post or sever one of the cell connectors.

The terminal lugs are held in the plug or receptacle by a bolt or screw, when loosened, will permit the lugs to be withdrawn for cleaning or for replacement.

After the broken or damaged terminal lug is severed from the cable, the proper length of wire to fit the terminal must be bared, cleaned and tinned. Some terminal plugs have short or shallow recesses into which the wire must be soldered and it is doubly important to clean and tin the wire to obtain a secure bond.

In reassembling the terminal lugs back into the receptacle or plug, make sure that the negative wire is placed in the negative side and that the terminal on the positive lead is secured on the positive side. If the leads are reversed in reassembling, the battery will be placed on charge in reverse and will be badly damaged.

Obviously, when changing or repairing plugs or receptacles connected to the charging equipment, the power should be shut off so that there is no voltage across the terminal lugs and no chance of a short circuit. *From a release for Gould-National Batteries, Inc., Trenton, New Jersey.*

Versatile Welding Machine

Welding engineers in Torrance, California, developed a new, versatile and simple automatic welding machine to speed up production and improve the quality of welds on large structural parts.

The new welding unit is a fully automatic submerged-melt welding machine incorporating a standard welding head from an older type machine. Base and track assembly is adjustable for fast alignment with the work. Track sections may be added for welding longer work pieces.

Welding head position is adjustable vertically and laterally on the carriage, and angular positions are provided by hinging the welding head

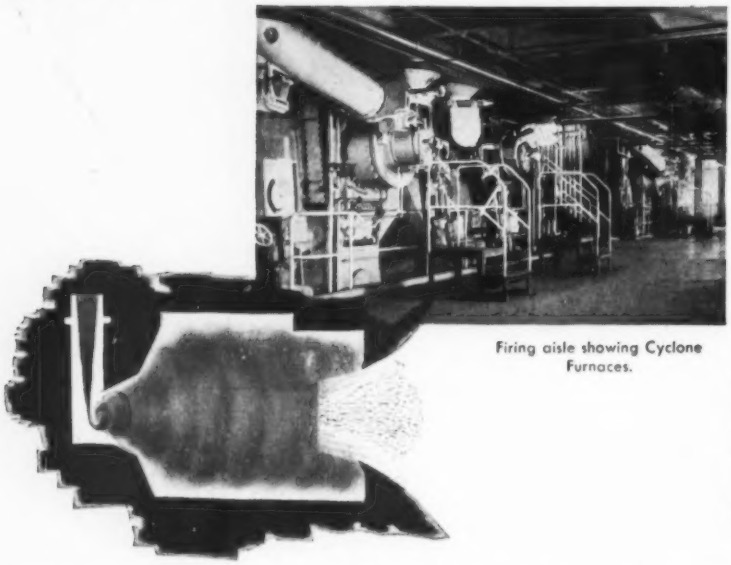
(Continued on page 38)

25% upward light
insures a new high in comfortable seeing by eliminating sharp ceiling contrast or harsh shadows
As illuminating engineers know, it is not TOO MUCH LIGHT which causes seeing discomfort. Often the cause is TOO MUCH CONTRAST... distracting contrast between unlighted ceilings and light walls. UPWARD LIGHT is one important way to solve this "brightness ratio" or extreme contrast problem.
The Benjamin "Task-Master" capitalizes fully on the Upward Light principle, by providing a 25% upward flow of light. This means an entirely new concept of lighting unit design . . . all the electrical control equipment is in the ends! All the wiring runs through a unique "spine" support which also doubles as a lamp shield! Thus, the entire body of the unit is left free to produce greater upward light, better quality light, without sacrificing high light output efficiency.
a step upward in seeing comfort...
BENJAMIN
"Task-Master"
FLUORESCENT LIGHTING SYSTEMS
a step forward in easier installation and maintenance
special "hook-up" design speeds installation!
patented "Springlox" lampholders cut maintenance cost!
Typical of "Task-Master's" pace-setting, new installation-and-maintenance methods is the practical "hook-up" design shown here. This patented feature enables the installer to temporarily hang one unit on another while connecting the furnished jumper wires. A boon to continuous-line jobs . . . saves manpower . . . speeds up installation.
"Springlox" is another exclusive Benjamin feature, yours with "Task-Master." These rugged, all-metal lampholders speed up and simplify lamp maintenance. Patented spring design insures against service interruptions due to faulty electrical contact. Self-adjusting action prevents lamps from dropping out or being shaken loose.
Get complete details on all the unique "Task-Master" features by sending for Bulletin AD 5906. It's yours free on request to Benjamin Electric Mfg. Co., Dept. P, Des Plaines, Ill.
A Product of Benjamin Electric Mfg. Co., makers of famous Benjamin and Leader Line Lighting Equipment and Sound Signals for Industry, Institutions and Commerce.
Sold exclusively through electrical distributors.

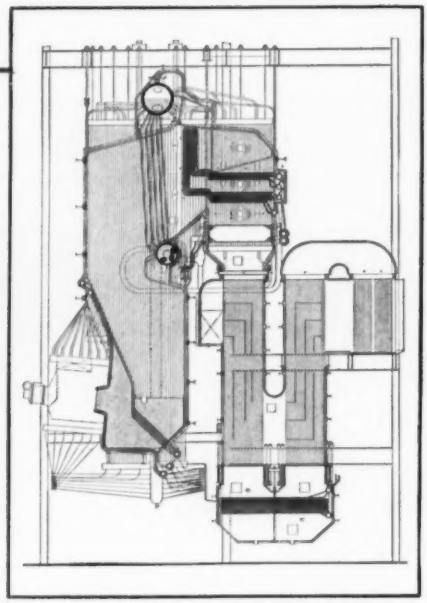
For more facts circle 529 on Reply Card

More B&W Pressurized Cyclone Furnace Boilers on the Line

LARGE CHEMICAL PLANT INSTALLS 4TH and 5TH CYCLONE UNITS



Firing aisle showing Cyclone Furnaces.



B&W Cyclone-Fired Radiant Boiler for a leading chemical manufacturer. Four units of this design are installed in one power plant. A similar unit is in operation at another of the company's plants. Each boiler normally generates 400,000 pounds of steam per hour with superheater outlet conditions of 1250 psi, 830 F. The design pressure is 1400 psi.

Having pioneered Cyclone Furnace firing for industrial steam plants, a large chemical manufacturer has recently placed its fourth and fifth Cyclone-fired boilers into operation. The first pressurized Cyclone-fired boiler ever built has been in successful continuous operation at one of this company's plants since February 1949.

ELIMINATION OF FLY ASH PROBLEM

Low fly-ash discharge to the stack, without the use of precipitators, was a prime consideration in the original selection of Cyclone Furnaces for the first three units back in 1946. Most of the coal-ash is converted to liquid slag which is removed through the slag tank, and can be disposed of readily. Thus, some of the most difficult problems in power-plant operation — preventing heavy stack discharge and eliminating the handling of large amounts of useless fly ash—are overcome. But, in addition to solving these problems, a whole host of other benefits have also been realized, and Cyclone Furnaces were thus the logical choice for the firm's two new units.

SIMPLIFICATION OF COAL BURNING EQUIPMENT

Simplification of the entire process of supplying and burning the coal is an important asset of Cyclone Furnace firing. It reduces maintenance costs, makes operation easier, and improves availability. This is because pulverizers, with their drives, fans, ducts, and burners are not needed, since the Cyclone Furnace uses coal which is merely crushed, instead of pulverized. This also increases safety and lends itself readily to "push-button" operation.

GREATER FUEL EFFICIENCY — WIDE COAL RANGE

Greater firing efficiency results from the great turbulence and high temperatures in the Cyclone Furnace. Carbon loss is practically eliminated. In addition, excess combustion air is reduced, bringing a corresponding reduction in heat lost to the stack.

A wide range of coals is burned in the Cyclones. Piney Fork coal is the designed fuel for this plant, but coals of many different varieties have been burned successfully.

PRESSURE-FIRING — NO INDUCED DRAFT FAN

Pressure-firing without induced draft fans is another pioneering achievement of this chemical company in its five Cyclone-fired units. Since the first boiler was placed on the line nearly five years ago, pressure-firing has contributed to smoother operation with reduction in fuel consumption. Having only forced draft fans on the unit eases the operator's tasks, simplifies controls, and saves considerable auxiliary power.

B&W's experience with Cyclone Furnaces, Pressure Firing, and so many other cost-saving engineering advances, is at your disposal when your next plant is being designed.

The Babcock & Wilcox Co., 161 East 42nd St., New York 17, N. Y.

BABCOCK & WILCOX

BOILER DIVISION

G-61P

For more facts circle 530 on Reply Card

BULLETINS just released and of immediate plant interest

ELECTRICAL

101 **Why Power at Load Centers**—Questions on selecting a load center unit substation to meet specific power requirements are answered in 20 pp Bulletin 11B6285B. Defines load center unit substations, tells how they can help improve low voltage caused by heavily loaded feeders, and how they can be placed indoors or outdoors near the load. Selection of proper equipment for a specific system is covered. Allis-Chalmers Mfg. Co.

102 **Improved Motors**—Manufacturer's new Tri-Clad "35" motors built in 1 to 30 hp ratings to latest NEMA dimensions, are explained in three full-color picture-story bulletins containing complete descriptions of new maintenance, performance and protective features. Sixteen-pp Bulletin GEA-6013 discusses dripproof models; 8-pp Bulletin GEA-6012, enclosed motors; and 14-pp Bulletin GEA-6027, new gear motors. General Electric Co.

103 **Wire Code Changes**—This wall chart shows 1953 changes in wire, cable, conduit sections of National Electrical Code. The front is a quick reference chart of presently approved wire and cable insulations, their allowable temperature ranges and uses. Reverse side shows other changes. Triangle Conduit & Cable Co., Inc.

104 **Variable Transformers**—Data on variable transformers given in Bulletin 553-S, 18 pp, includes design and construction, dimension and performance characteristics of models for built-in and bench applications. Terminal and tap arrangements, as well as circuit diagrams, are included. Standard Electrical Products Co.

105 **Dry Type Transformers**—Manual T2 is a 12-pp guide for electricians, maintenance personnel in the proper installation and care of dry-type transformers. Simple trouble chart helps find trouble spots and gives remedies. Hevi Duty Electric Co.

106 **For High Current Testing**—Catalog 953 describes six models of a portable high current test instrument designed for economical and safe checking and calibrating of current actuated devices. Fully illustrated; includes specifications, application data and prices. Multi-Amp Corp.

107 **Time Switch**—Selection and application information on time switches, process timers and time meters are discussed in Catalog GEA-5965, 24 pp. Available types and models are described, as well as features, specifications, operating data and pricing information. General Electric Co.

108 **Magnetic Air Circuit Breaker**—Design and construction features of magnetic air circuit breaker arranged for installation in horisontal drawout switchgear rated 13.8 kv are described in Bulletin 12B7993. Diagrams show how breaker interrupts short circuit current; text gives purpose of arc chute and contacts. Includes indoor and outdoor floor plans. Allis-Chalmers Mfg. Co.

VALVES, TRAPS, PIPING ACCESSORIES

110 **Fluid Control Equipment**—Small valves, pressure regulators, stainless steel cylinders, flow gages are described and illustrated in 68-pp Catalog 2. Provides application suggestions and ordering information as well as detailed engineering data. Also listed are large and small capacity oxy-gas torches. Hoke Inc.

111 **Pressure Reducing Valve**—Bulletin 228, 8 pp, describes and pictures a pilot-operated pressure reducing valve for automatic control of reduced pressure required in steam service. Gives advantages of the valve, illustrates method of installation and explains its operation. McAlear Mfg. Co.

112 **Valve Selection Chart**—A handy, desk-size flexible plastic chart shows port and stop arrangements of multiport valves. Front of chart has diagrammatic sketches of four types of valves, each with revolving two-color plastic disc attached to center to illustrate fluid traffic control. Back of chart shows other positions possible with the different multiport arrangements. Rockwell Mfg. Co.

The Reader Service Card nearby needs no postage. Just circle item numbers of all bulletins wanted. Be sure to include your name, your job title and company name.

113 **Filterless Purifiers**—Bulletin 201 tells how company's Type Hi-eF purifiers remove dirt and moisture from steam, air, vapors and gases. Selection charts, installation diagrams, tables of dimensions and weights are included. Purifier Division, The V. D. Anderson Co.

114 **Wrought Iron Nipples**—This informative little folder explains how to identify wrought iron nipples. Provides dimensional data and lists stock sizes and lengths for standard weight and extra strong types. Covers nominal size, close nipples and special types, black and galvanized. A. M. Byers Co.

115 **Thermodynamic Steam Traps**—Eight-pp Temporary Bulletin 255A introduces manufacturer's new thermodynamic steam traps, small units designed for convenience of installation and ease of maintenance. Explains their applications in steam mains and separators, and where conditions of water hammer and corrosion are present. Provides dimensions, specifications and capacity data. Sarco Co., Inc.

116 **Pipe Insulation**—Bulletin F 1-100 features on-the-job installation photographs of cellular glass insulation for pipe temperatures between -300 and 900 F. Complete listing of physical properties and condensed recommended specifications make are provided. Pittsburgh Corning Corp.

VENTILATING AND AIR CONDITIONING

117 **Propeller Fans**—Thirteen types of fans, including panel, high pressure and direct-drive low noise models, are shown in 40-pp Bulletin A-109. Also describes three types of roof ventilators, unit heaters and intake air units. Includes specifications, dimensions and performance figures on all equipment, also engineering data. Discusses corrosion-resistant materials and coatings and provides table on suitability of special materials and coatings for use in a wide variety of industrial fumes. Hartzell Propeller Fan Co.

December, 1953

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PLANT ENGINEERING

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Use this space to ask for tear sheets, other information wanted.

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118 **Air Conditioning Plenum**—This 16-pp booklet, based on research by Illinois Institute of Technology, answers questions on the use of the plenum above luminous ceilings for heating and/or ventilating. Booklet describes pressure loss, flow pattern, heat transfer, plenum supply and exhaust, together with additional material on sound absorption and acoustical characteristics. Luminous Ceilings, Inc.

CONSTRUCTION AND MAINTENANCE

119 **Steel Rolling Doors**—Bulletin 301, 12 pp, illustrates manufacturer's line of steel rolling service doors for warehouses, garages, factories. Includes fire doors, grilles, aluminum rolling counter and specialty doors. A series of charts simplifies selection of proper gage and type of slats, guide type, power units. Blueprints of 12 basic door types show dimensions. Specifications are also given. The Cookson Co.

120 **Overhead Doors**—Various models of wood Roi-Top doors, their specifications and installation types and clearances are presented in Bulletin 50, 12 pp. Table shows track sizes and operations for different size doors. Kinnear Mfg. Co.

121 **Industrial Insulation**—Design and engineering data on Insulite industrial insulation is given in Bulletin 79. Describes six types of this wood fiber insulation board, and discusses fabrication. Presents some specialized uses for this material, as in roofs, flush doors, air conditioning units. Table shows physical properties of Insulite and conductivity chart shows variation with density and mean temperature. Insulite Div., Minnesota and Ontario Paper Co.

122 **Walls Breathe?**—A comprehensive review of modern methods of protecting masonry walls from water penetration and disintegration is given in this 40-pp booklet. Explains complexities of controlling water in masonry; covers preventive, remedial and restorative treatments, and discusses main types of construction and the problems of each. One section of the book tells results of water penetration into masonry and reasons why treatment must permit walls to breathe. Also provided is detailed information on selecting right treatment. Western Waterproofing Co.

123 **Industrial Painting Manual**—"See-Ability Painting Guide," 64 pp, shows by photos and color chips how to select right paints and colors for plant exteriors, interiors and machinery. Shows safety code colors and pipe identification color systems, warm and cool color groups. Tells you how to put paint on your payroll and how to organize plant painting to minimize production delays. Also presents coatings for product finishing. Industrial Div., Armstrong Paint & Varnish Works.

124 **For High-Level Jobs**—How difficulties, hazards and high costs of overhead maintenance can be eliminated is told in this bulletin on company's Lift-A-Loft. Shows how this high lift electric truck holds a man and his tools on its platform, taking him right up to the job. Gives specifications of the truck, stresses advantages in lighting maintenance, other overhead work. Barrett-Cravens Mfg. Co.

HEATERS AND HEATING

125 **Unit Heaters**—Application and engineering information on both horizontal and downflow types of unit heaters is presented in 32-pp illustrated Catalog UH C-1. Stresses advantages of these in various space heating applications. Tells how to select the right heater for the job, where to locate it and how to mount it. Full capacity data are included, also installation and piping recommendations, wiring diagrams. Fedders-Quigan Corp.

126 **Industrial Ovens**—Thirteen types of company's Convectioneered ovens, which apply principles of forced convection heating to various industrial processes, are illustrated and described in 12-pp Bulletin 200. These ovens serve foundries, metal finishers, plastics producers, rubber manufacturers. Component parts are discussed in detail. The W. W. Sly Mfg. Co.

127 **Heaters and Controls**—Announced as one of the most comprehensive pieces of literature on electric heating elements and equipment, this catalog is comprised of more than 25 bulletins. These cover strip and flat type heaters, immersion heaters, cartridge heaters, water and oil preheaters, air heaters, oven heaters, thermostats, switches, bus bar and other accessories. Book is thumb indexed, well illustrated; provides application data, construction details, sizes, prices. Industrial Engineering and Equipment Co.

MATERIALS HANDLING

128 **Hand, Electric Hoists**—Bulletin 1567, 12 pp, illustrates hoists for many lifting jobs, and explains how manufacturer's hoists save time, money and manpower in various industries. Differential, screw gear and spur geared hand hoists are compared for relative efficiency and initial costs. A check chart shows features incorporated in four types of electrical hoists. Also discussed is a tool for either pulling or lifting. The Yale & Towne Mfg. Co.

129 **Portable Hoists**—Description and specifications of more than 100 types and sizes of portable hoists appear in 8-pp Bulletin CL. They include ratchet lever hoists in roller and coil-chain models, with capacities from ¾ to 15 tons, standard and specialized spur gear hoists, Quik-Lift electric hoists. Coffing Hoist Co.

130 **Conveying Systems**—How this manufacturer's conveying systems are being used in handling dry pulverized and granular materials is shown in illustrated Bulletin FK-26, 16 pp. Types of systems and component parts are described and many typical installations pictured. Fuller Co.

131 **Conveyor Belt Control**—A technical bulletin, "Materials Handling for Industry," discusses the hyperbolic principle applied to conveyor belts, steel band conveyors or cable hauling. Discusses difficulties caused by weather, temperature, moisture conditions, overloading and poor maintenance. Provides a solution to belt destruction caused by these conditions and advocates the use of hyperbolic control mechanisms. Details of design and construction are included. Knapp Mills, Inc.

TOOLS, WELDING, MACHINE SHOP EQUIPMENT

132 **Electric Tools**—Pocket-size Catalog 201, 44-pp, describes and illustrates 52 portable electric tools and specialized attachments for building and wood-working in industry and maintenance. Includes 135 photos of electric tools and their uses, also specifications and prices for electric saws, sanders, bench grinders, many others. Porter-Cable Machine Co.

133 **Air Tools**—Catalog JE-1680, 12 pp, provides descriptive information and specifications on a line of lightweight air-operated drills, grinders, screwdrivers and nut setters. Fully illustated, also explains engineering advantages of these compact tools. Thor Power Tool Co.

134 **Pipe Tools**—A new aluminum power drive combining lightness and durability is featured in this illustrated bulletin. Explains portability of the drive, easy thread-

(Continued on page 147)

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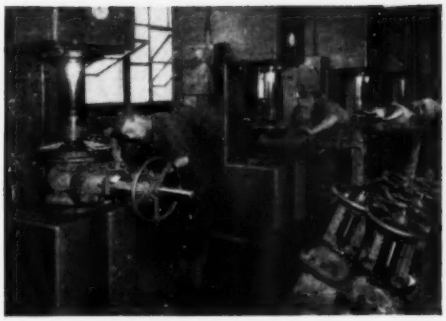
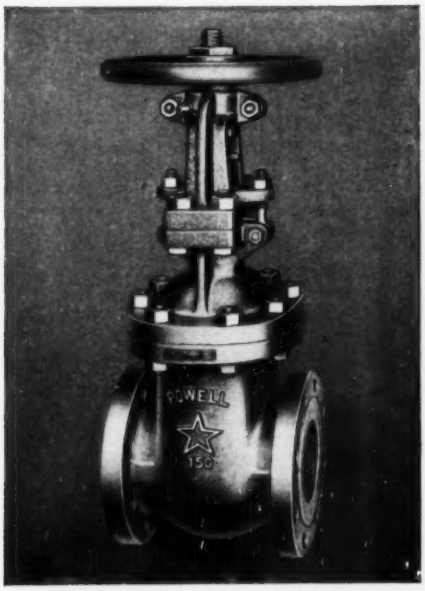


The Finishing Touch

Small details can make a big difference in trimming a tree . . . and in manufacturing valves. For example, *every* Powell Valve part must pass *rigid inspection*. Then, as a final, finishing touch, each Powell Valve is subjected to *actual line tests*.

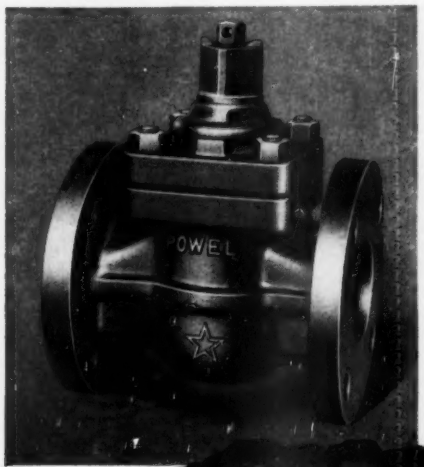
It's these seemingly small details that have helped Powell Valves maintain their record of dependability since 1846. Powell has probably done more valve research, solved more valve problems, and makes more types of valves than any other organization in the world.

With Powell Valves on the job in your plant, you'll say every day's a holiday from flow control worries. Following are just a few of the valves that have the gift of dependable service you want—and need. They're available through distributors in principal cities. If a distributor is not located near you, just write us. We'll be pleased to tell you more about these valves—and our complete line.

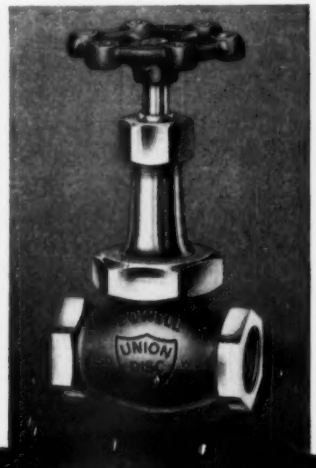


CAST STEEL GATE VALVE *(Fig. 1503)*. 150 pounds. Flanged ends, bolted flanged bonnet with outside screw rising stem and yoke. Solid wedge. Available in sizes 1″ to 24″, inclusive.

LUBRICATED PLUG VALVE *(Fig. 2201)*, flanged end, available with screwed or bolted glands. Semi-Steel valves available for 175 and 200 pounds W.O.G. Carbon Steel valves available for 150 and 300 pounds W.P.



BRONZE GLOBE VALVE *(Fig. 150)* for 150 pounds at 500 F. Screwed ends, union bonnet, renewable vulcanized composition disc. Sizes ⅛″ to 3″, inclusive.

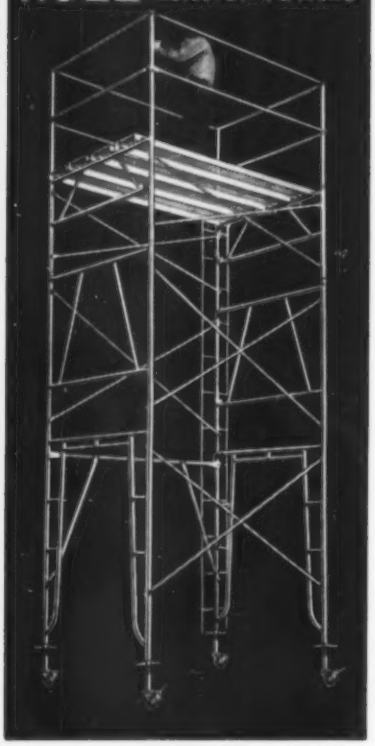


P V

2 WAYS to S-T-R-E-T-C-H YOUR MAINTENANCE DOLLAR

LIKE SEVEN LEAGUE BOOTS, these practical work towers will *stretch* your working stride, help complete more work in less time. They speed overhead maintenance on plant equipment and buildings because they put your skilled hands *where the work is* . . . quickly and safely. SAFWAY work towers come in two useful types:

ROLL TO THE JOB WITH BUILT-UP TOWERS



Towers of any height or shape easily assembled with standard tubular steel SAFWAY Scaffolding. Parts are interchangeable—can be re-used in other forms. Built-in ladder. Swiveling casters lock at working position. 8, 12 and 16-ft. towers available in complete "packages."

RISE 7 TO 17 FEET WITH PUSH-BUTTON CONTROL

SAFWAY Moto-Lift reaches work 22-23 ft. high. Hydraulic lift extends 10 ft. in 25 sec. No electric connection—auto battery powers motor to raise tower 45 times per day on one charge. Recharges overnight. Tower telescopes to pass through low, narrow doors. Positive safety device.

Learn how you can complete elevated maintenance faster—cheaper—safer with these multi-purpose work towers. Write for this new bulletin.

SAFWAY STEEL PRODUCTS INCORPORATED
6231 West State St.
MILWAUKEE 13, WIS.
Manufacturers of Tubular Steel Scaffolding and Equipment

RENTED and SOLD by distributors everywhere

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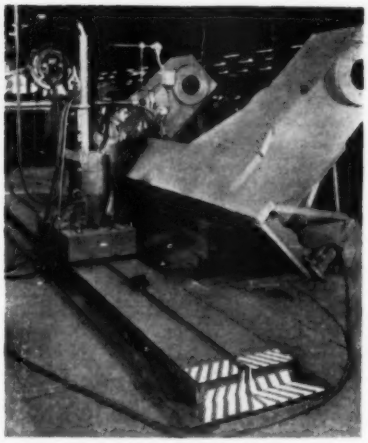
PLANT ENGINEERS' DIGEST

(Digest begins on page 28)



Track-mounted machine is shown doing a welding job on stretch press frame

on the end of the horizontal supporting arm. Welding speed is controlled by varying the speed of the carriage. Two 600-ampere welding generators supply current to welding wire 3/32 in. to ¼ in. in diameter. Flux is fed by compressed air.

The new machine multiplies the volume of work of a man with manual welding arc approximately four times. Weld appearance is greatly improved and the possibility of defects is virtually eliminated. *From a release for The National Supply Company, Torrance, Calif.*

On Automation

CONVEYORS, although originally simple in design, are now being developed to perform complex operations with emphasis on automation.

This mechanical cycle of movements produces steady, peak production and reduces cost, both of which are of paramount importance to our economy, with lower cost commodities within reach of many more people. Greater consumption results, requiring increased production and further expansion of facilities and equipment.

Small plants, as well as large plants, can benefit by this systematic integration of operations. In planning automation, select the conveyor which adapts itself to the manipulation movements required, and do not try to make one type of conveyor do all operations. Design for sturdy construction to eliminate vibration. Do not crowd into too small a space, or try to make movement too abrupt.

Among other things, limits and escapements should be protected from shock and, when possible, allowance should be made for overtravel. Movements should be ample

G-E MOTOR CONTROL CENTER— 4 EASY-MAINTENANCE FEATURES

1 ACCESSIBLE UNITS (all components on one frame) are interchangeable, terminals front-connected.

2 LIGHTWEIGHT UNITS (Size 1 only 30 lbs.). To remove, just disconnect terminals. Stab-on connectors make bus ties automatically when replaced.

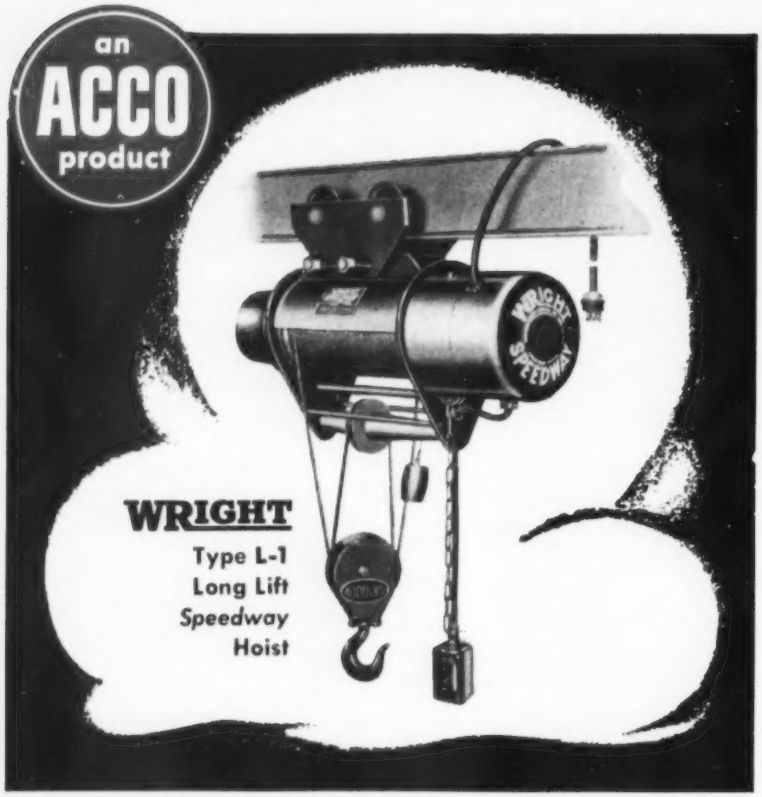
3 SAFE, EASY SERVICING in "disconnect position." Terminals easily reached; 4" vertical wiring trough.

4 SAFE OPERATION even with some units being serviced. Personnel isolated from live bus by steel barrier.

For more information, contact your G-E Apparatus Sales Office or write for Bulletin GEA-4979A. Section 781-8, *General Electric Company, Schenectady 5, New York.*

GENERAL ELECTRIC

an ACCO product



WRIGHT
Type L-1
Long Lift
Speedway
Hoist

You Can Lift 2 Tons 20 Feet with this WRIGHT Speedway Hoist

• If the ceiling is high and material must be moved over machinery and partitions, or if you want to lift from basement to second floor, here's a hoist that will do it.

The L-1 WRIGHT *Speedway* has a lift of 20 feet and is reeved with a 4-part single line that wraps in a single layer on a grooved drum. In either of two speeds, lifting or lowering is smooth and stable, so it is fine for either intricate lifting jobs or production material handling.

Motors of the L-1 WRIGHT *Speedway* have 30-minute ratings. In addition the L-1 has the five key long life features of all Frame 1 WRIGHT *Speedway* Hoists. These are: heat-treated and surface-hardened alloy steel gears, hard alloy silver electrical contacts in controller, heavy duty crane type safety limit stop, automatic multiple disc load brake, and ball bearing gear shafts.

And there are others.

See your WRIGHT Hoist distributor today or write today to our York, Pa., office for DH-425

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WRIGHT HOIST DIVISION
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Trolleys
Cranes

For more facts circle 534 on Reply Card

PLANT ENGINEERS' DIGEST

(Digest begins on page 28)

to eliminate micrometer adjustments which will result in lower first cost of equipment, and give longer life.

Select the most suitable type of power or energy to perform manipulation necessary, and select simple controls to reduce cost and maintenance. Rearrange sequence of operations, if necessary. Provide new fixtures or change old fixtures to simplify manipulation or positioning of parts.

If first appropriations are not enough, go to management for additional funds to permit ample design for successful operation. *From an A.S.M.E. release based on address of O. Svoboda of E. W. Buschmann Co., Incorporated.*

A Different Type of Rivet

BLIND SPOTS encountered in riveting jobs are as easy to handle as open sections with the use of an English rivet design introduced to this country.

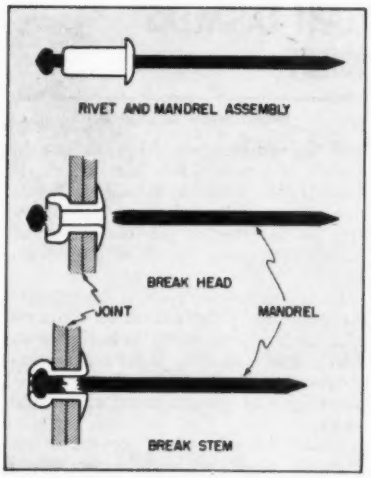
The fastener of this design is known as the Pop rivet because of the speed with which it can be applied to the work. The rivet can be driven by inexperienced operators at a rate up to 1200 an hour. It has been manufactured for a number of years by the Geo. Tucker Eyelet Co. Ltd.

Deep drawn from strip stock, the Pop rivet can be used to fasten most commercially available metals and alloys. The fastener consists of the rivet itself, and an inserted mandrel of high strength steel. This mandrel looks much like a finishing nail.

With its rivet attached, the mandrel is slipped either into predrilled holes in the work to be fastened, or into the fastening tool and then into the hole. The fastening tools can be operated manually and pneumatically. They can be fitted with interchangeable heads and extensions to operate at any desired angle or position.

In operation, the collet of the tool grips the shank of the mandrel and pulls while the nose of the tool presses firmly against the head of the rivet and holds it clamped tightly against the face of the section to be fastened. Simultaneously, the collet pulls the shank of the mandrel, thus expanding the inside end of the rivet to fasten it tightly against the inside surface of the work. This action serves to draw the sections firmly together and clinch them in position.

The mandrel is so designed that the head will break when the expansion has reached a point sufficient to provide maximum holding powers. The head then falls off and the shank is pulled through the rivet. If pre-



Rivet and mandrel assembly prior to use appears at top. Applications of two types, namely the break head and break stem are seen beneath top view

ferred, the mandrel head may be retained in the end of the rivet, through the use of the break stem type of mandrel.

The hollow nature of the rivet, in some cases, such as in roofing, requires that the hole be covered. This can be accomplished by filling with a compound or by capping. As yet, sealing caps are not recommended in pressure service or for handling gases.

The rivets are available in Monel and aluminum. Much of the production to date has been Monel, because of the high strength of this nickel-copper alloy and its adaptability to upsetting and other forming. *From Inco Magazine, published by the International Nickel Co., Inc., New York, N.Y.*

Care of Exhaust Systems

EQUIPMENT which is provided for the exhausting of atmospheric contaminants and which helps to provide a healthful working environment belongs in that group of equipment which is "non-productive." As such, the tendency is to let equipment "take care of itself," particularly in a small plant.

The true value of such equipment to the operation of plant is frequently difficult to assess. It affects such areas as employee morale, labor turnover, housekeeping costs, lost time, and compensation costs. It is very difficult to place a dollar sign on items like these.

This can easily be recognized when it is seen that in some small plants such equipment is installed primarily as a result of pressure from outside organizations, such as labor unions, state officials, and so forth.

All too frequently then, after the initial investment of hundreds or perhaps thousands of dollars, the equipment is forgotten and is idle.

Here's a Handy Chain for Positioning Loads

• The short links in this 125 Endweldur ACCO *Registered* Sling Chain can be wrapped around small projections and over sharp corners. The greater tensile strength of the alloy material permits use of light weight chain that is easy for the machine operator to handle. The two 6-foot legs can be used as a double bridle, double choker, or in a double basket hitch as illustrated.

This is only one of many types of ACCO *Registered* Sling Chains available for lifting castings, sheet steel, pallets, machines, machine parts, quenching baskets, and the like. You can get AMERICAN Sling Chains as small as ¼" or as large as 1¼"—with sling, grab, or foundry hooks—or special hooks for plates, etc. They are all individually proof-tested, registered, and an identification ring is permanently attached.

See your AMERICAN CHAIN distributor today or write our York, Pa., office for copy of DH-130

ACCO

TRADE MARK

AMERICAN CHAIN DIVISION
AMERICAN CHAIN & CABLE

York, Pa., Atlanta, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, Portland, San Francisco, Bridgeport, Conn.

American Chain

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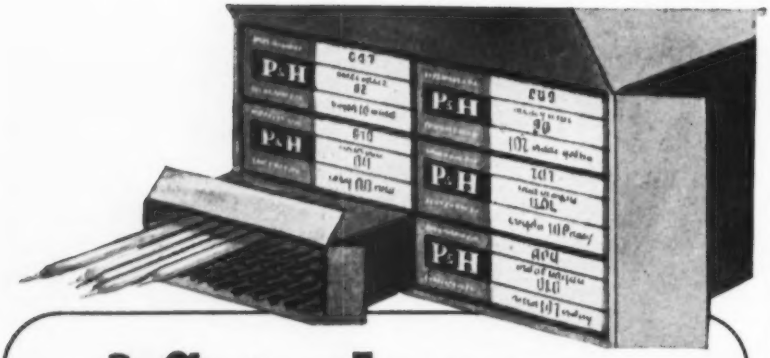

Cuts down your inventory

of seldom-used electrodes

P&H Maintenance Pack

Small-package assortment of electrodes for repair and maintenance welding

You don't have to buy seldom-used electrodes in quantities larger than you need. With the P&H Maintenance Pack, you can keep some of each type on hand—economically. This assortment includes seven different electrodes packaged to stay dry — and clearly labeled to make selection easy. You're equipped to do all kinds of repair and maintenance jobs—get fast, easy, sound welds.

Let the P&H Maintenance Pack save you time, trouble, money. Order from your P&H representative or local distributor.

7 different electrodes

(Approximately 27 lbs.)

- **AC-3, 1/8", 5/32", 3/16"** — For all position welding of mild steels and sheet metal. AC or DC.
- **AC-1, 5/32"** — For mild steels. AC or DC.
- **70LA2, 5/32"** — For high-carbon, alloy, high-sulfur, free-machining, cold-rolled, and other hard-to-weld steels. Ideal for steel casting repairs. AC or DC.
- **Harstain, 1/8"** — For spring steels and stainless steels of all kinds. AC or DC.
- **Nicast "55", 1/8"** — For machinable welds on cast iron. Nicast welds are strong and non-porous.

$13.90 complete assortment

P&H WELDING DIVISION
HARNISCHFEGER CORPORATION
4577 West National Ave., Milwaukee 46, Wis.

the P&H Line

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For more facts circle 536 on Reply Card

PLANT ENGINEERS' DIGEST

(Digest begins on page 28)

If the employees think to put in a dab of grease, it's lubricated. If they think to clean it out, it functions properly. Otherwise it operates at a fraction of efficiency or possibly ceases to function altogether.

In order to carry on a systematic maintenance program on an exhaust system, it is necessary to assign certain functions to individual employees, and schedule daily, weekly, monthly and semi-annual or annual tasks.

Each week, static pressure or velocity readings should be taken at each hood and checked against similar readings taken after original installations.

Some of the larger companies have found the use of mimeographed forms on which to record these readings to be helpful. Low readings show plugging of ducts, belt slippage, fan blade wear, improper collector maintenance and many other things.

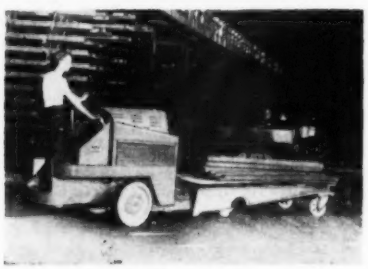
Static pressure readings taken on both sides of the collector, that is a high pressure difference shows a dirty collector. A low static pressure reading at the fan usually shows a decrease in fan performance which could be due to belt slippage, incorrect rotation of fan or corrosion or dirtying of fan blades.

A factor that is sometimes overlooked is the inspection of structural members, supports and hangers. Enough duct work has fallen down and cyclones blown over, to remind us of the need of such inspections.

The best and easiest way to insure the continued effectiveness of exhaust controls is to maintain the control equipment at its installed efficiency. *From an article in the Safety News Letter, published by the National Safety Council, Chicago, Illinois.*

Platform Dollies Aid Handling

FOR HANDLING MATERIAL in the manufacture of a wide variety of truck bodies, the Hercules Steel Products Co. of Galion, Ohio em-



Platform truck and dolly form a good team for the movement of long material

Now... they're even PUMPING POTATO SALAD!

An example showing how the versatile ® MOYNO PUMP may solve your pumping problem

As you can imagine, any conventional pump would quickly make *mincemeat* out of potato salad! But not the versatile MOYNO Pump! In fact, this unique pump was the answer to a years-old materials handling problem in an Eastern food processing plant.

Why? Because of the Moyno "*progressing cavity*" *principle*—found in no other pump. Instead of valves and pistons that stick, or vanes that cause churning and turbulence, the Moyno has a simple rotor, operating within a stator. The small illustration shows how progressing cavities are formed as the rotor turns. These cavities move along smoothly, without closing up or squeezing the material. That's why Moynos carry liquids, pastes, solids in suspension, abrasive-laden slurries—*almost anything that will go through pipe*—with positive, non-pulsating pressure!

Potato salad is only one of the many successful, dramatic applications for Moyno Pumps. You may be able to save money or solve a problem by finding out more about the world's simplest, most versatile pump!

If you have a pumping application—in your plant or in your product—write today for free copy of Bulletin 30-PE. It will give you complete facts!

Features of the MOYNO that may solve YOUR pumping problem

Positive Displacement—Moynos are available to pull up to a 29" vacuum while discharging under pressure. Big Moynos deliver up to 250 g.p.m. at pressures to 600 p.s.i.

Gentle—no churning; won't break up semi-solids . . . won't aerate liquids.

Reversible—pumps with equal efficiency in either direction.

Trouble-Free—self priming; won't cavitate or vapor-lock. Just one moving part—no valves to stick, no pistons to gum up. Built for tough service. Easy to maintain.

ROBBINS & MYERS, INC.

SPRINGFIELD 99, OHIO • BRANTFORD, ONTARIO

Fractional & Integral h.p. Motors & Generators

Electric Fans

Electric & Hand Hoists & Cranes

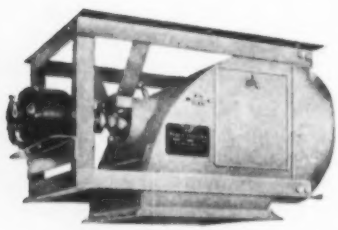
Moyno Pumps

Propellair Industrial Ventilating Equipment

For more facts circle 537 on Reply Card

"...Let's cut this stack off here and put a Wing Draft Inducer on the boiler...We'll save the cost of the chimney, have better draft and a better looking building."

If you are building or rebuilding or increasing the size of your boiler plant, a costly, tall chimney can add considerably to the expense. And a well planned architectural design can be ruined with an unsightly, towering stack.



WING DRAFT INDUCERS eliminate this problem, providing positive, adequate, uniform draft regardless of surrounding conditions, or variable weather. They cut operating costs too, by giving higher CO_2's. Smoking is reduced or eliminated. Higher boiler capacity is possible.

Write for Bulletin I-52

Wing

L. J. Wing Mfg. Co.
177 Vreeland Mills Road
Linden, New Jersey
Factories: Linden, N.J. and Montreal, Can.

For more facts circle 538 on Reply Card

PLANT ENGINEERS' DIGEST

(Digest begins on page 28)

ploys unique company-built dollies.

These units, which vary from nine to 10 ft in length, are equipped with casters on their outboard end. They are so designed that they may be raised and moved by truck platforms.

In this way, loads up to 18 ft in length can be handled by a standard truck with a 54 in. long platform. Likewise, although the trucks' capacities are only 6,000 lb, loads weighing up to 10,000 lb can be handled safely and easily because dollies help support the weight. *From a release for Elwell-Parker Electric Co., Cleveland, Ohio.*

Motor Armature Impregnation Process Reduces Freezing

ELECTRIC MOTORS in fast cross-country Diesels operate at high speeds; often under conditions of extreme high temperature and severe vibration.

As vibration and temperature increased with the higher speeds of recent years, and motors aged, railway maintenance men noted a tendency for armatures to swell, sometimes to such a degree as to "freeze" in the stator.

The possibility of this occurrence has been reduced by impregnation chambers, using a special varnish of high bonding characteristics. Ten or twelve such armatures are treated monthly at the general shops of the Southern Pacific Co. in Sacramento, Calif.

The armatures are baked for several hours to remove most of the moisture; then cooled for several minutes under forced draught and lowered into the impregnating chamber.

After the chamber is sealed a vacuum of 27 in. of mercury is drawn to remove all air and the residue of moisture from the armature. Bottled nitrogen is then introduced into the impregnating chamber at a pressure of 35 psi, forcing the varnish into the evacuated pores and interstices.

Vacuum is then drawn in the storage tank to return the surplus varnish; then renewed on the impregnating chamber to remove excess varnish and air bubbles. After baking to polymerize the varnish, the armature is ready for installation.

Bonding of the many windings and elements of a large armature eliminates the tendency of the wiring to swell under heat or move centrifugally at high speeds. It also improves dielectric properties of the insulation. *From Stokes News, published by F. J. Stokes Machine Co., Philadelphia, Pennsylvania.*

Better working conditions with COOLITE

General Contractor—
Joseph Bucheit & Sons, Youngstown, Ohio
Glazing—Pittsburgh Plate Glass Company,
Youngstown, Ohio

There is no Substitute for GLASS!

It is non-combustible . . . won't burn . . . it is rigid . . . doesn't sag or warp. It has a permanently hard, impervious surface, not affected by time, abrasion, or exposure to the elements. It won't corrode or stain. It resists chemicals. It is easily installed, maintained and cleaned by conventional methods.

Employees of the General Fireproofing Co., modern office furniture and fixtures manufacturer in Youngstown, Ohio, see better, feel better, work better in areas flooded with conditioned daylight. Eye comfort is an important factor in improved working conditions; so approximately 29,000 sq. ft. of Coolite, Heat Absorbing and Glare Reducing Glass were installed to provide copious quantities of natural illumination at low cost. For Coolite removes the harmful elements of "raw" sunlight . . . cuts glare that causes eye fatigue and costly mistakes . . . absorbs up to 50% of solar heat to make interior more comfortable.

Rolled, Figured and Wired glass by Mississippi is "visioneered" for better daylight illumination. Available in a wide variety of surface finishes all scientifically designed to distribute light to best advantage. In your building or remodeling projects specify Mississippi Glass.

Send for free catalog, Coolite Heat Absorbing and Glare Reducing Glass.

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WORLD'S LARGEST MANUFACTURER OF ROLLED, FIGURED AND WIRED GLASS

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A-C AMMETER
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AMPERES
GENERAL ELECTRIC

COMPLETELY NEW—

G-E Hook-on Recorder

Here is a brand new solution to one of your old electrical-testing problems. General Electric's new CF-7 portable hook-on recorder (volt-ammeter) gives you the first convenient means of recording current without having to cut conductors or interrupt service.

By simply attaching leads, you can get voltage records over a wide range. The CF-7's butyl-molded transformer is insulated for 8700 volts.

FAST HOOK-ON INSTALLATION

You can install the CF-7 in little more time than it takes to use any hook-on instrument. Simply mount the recorder, select a range, attach leads, and hook on. Simplicity makes the CF-7 ideal for on-the-spot checking of loads on motors, circuits, and transformers.

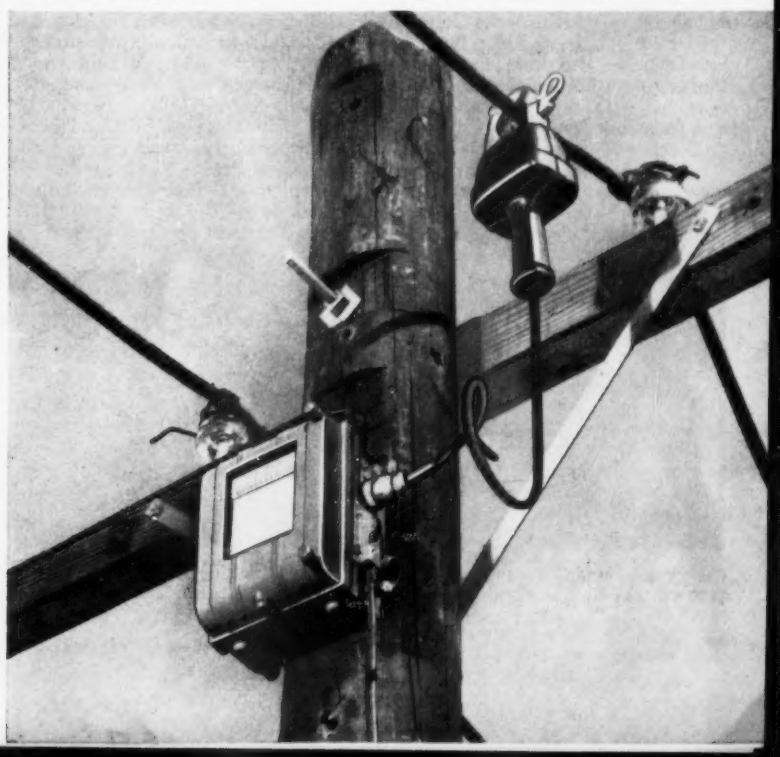
MINIMUM SERVICING

Consisting of a hook-on current transformer, connecting lead, and inkless recorder, this new instrument offers you:

- Inkless recording for minimum servicing, clean records;
- Weatherproof construction for outdoor and indoor use;
- Accuracy to 3% of full scale (4% above 625 amperes);
- Seven ranges—15/75/150/750 amperes, 150/300/750 volts.

See the CF-7 hook-on recorder at the Plant Maintenance and REA shows in January. For full details, contact your Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y. 602-267

SELF-SUSPENSION of the current transformer is made possible by a spring latch. Self-locking simplifies installation in such applications as checking of line loads.

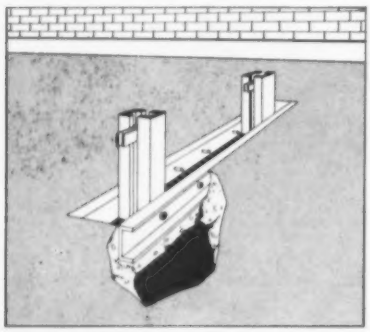


OPERATION AND PRODUCTION pointers for the industrial plant engineer

Edited by H. E. B. Anderson

Floor Rack Holds Heavy Plate

Contributed by Alois Nowak
Allis-Chalmers Manufacturing Co.



Sketch of bedplate shows channels sunk into shop floor to support the uprights

ONE PROBLEM of welding on unwieldy pieces has been solved by the installation of a sliding rack in the shop floor. This rack makes it possible to weld support bars to large bedplates without requiring constant use of a crane to hold the plate on edge while the weld is being made.

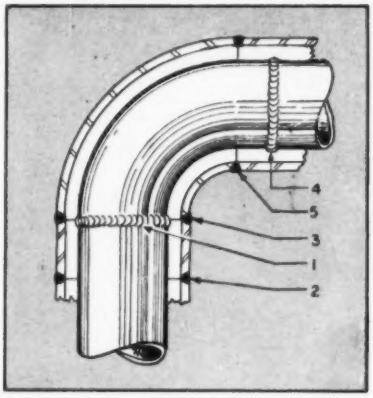
The base of the rack is made of two lengths of 6-in. channel set into the concrete floor. The upright members are of 4-in. channel. Both the base and the uprights are drilled for holding bolts, to secure the uprights in position.

Where 10- and 18-ft long bedplates are being handled, this rack increases the safety of the operation a great deal, by giving solid support to the heavy bedplates as they are being welded.

Welded Turns for Jacketed Piping

FABRICATION PROCEDURE for making directional changes in jacketed piping has been simplified recently. Developed by Tube Turns, Inc., a method of using welding fittings for the changes in direction reduces the problem to a relatively simple welding sequence.

The jacketed fitting combination consists of long and short radius 90 deg elbows, with their center line radii closely matching. On one end of the inside elbow, a tangent extends beyond the corresponding end of the outside elbow. Or. the opposite end of the inside elbow a short piece of pipe is attached to facilitate the installation. The welding sequence is very important, and must be followed.



Numbers indicate sequence of welds to be made in fabricating jacketed turn

This type of jacketed fitting lowers

Floor Patching with Asphalt Emulsion Mastic Simple and Quick Method

HOLES IN industrial plant floors are not only dangerous but costly. They can wreck equipment and add greatly to worker fatigue, if the workers are required to push or move wheeled carts over the broken floor. They can be patched with asphalt emulsion mastic simply and economically, following a procedure suggested by the Flintkote Company.

First, the hole and the floor surface around the hole are cleaned thoroughly. Oil or grease can be removed with caustic cleaner. With a stiff broom, remove all dust, dirt, and other loose material. Finally, scrub the hole and surrounding surface with clean water; leave the surface damp but not wet.

Next, apply a prime coat of the asphalt emulsion, diluted (up to 15 per cent) with clean cold water, to thin consistency. Scrub this liquid well into the surface of the hole and the area surounding it. Allow to dry until tacky.

Mix dry measured quantities of cement and sand with water to a fairly stiff consistency, then add measured quantity of flooring emulsion and continue mixing and adding water until mastic is of uniform color and composition. The proportions recommended for average materials are: 1 volume of Portland cement, 2 volumes of asphalt flooring emulsion, and 3½ to 4 volumes of clean sharp sand. The asphalt emulsion must be of the type that will mix with Portland cement.

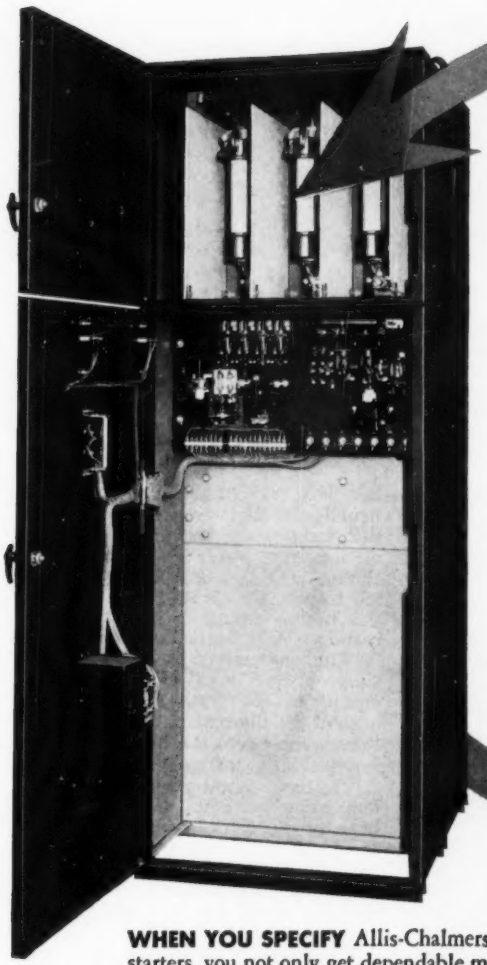
Best results are obtained by keeping the mix as heavy as possible. Add water sparingly to avoid a sloppy mix.

Fill the hole completely and leave no voids or depressions. Straightedge to level the patch with the floor. With a trowel, extend mastic mix to feather edge on floor surface around the hole, but not over any part of the surface not primed.

Drying should be retarded by covering with moisture-retaining paper or cloth cover. Under normal conditions of temperature and humidity, the patch should be left to dry for at least 12 hours, unless it is completely covered by a steel plate in order to avoid damage and wheel cutting by heavy loads.

Sequence of operations in patching a hole in concrete floor is pictured. 1) Hole is swept clean and 2) coated with a prime coat of asphalt emulsion. 3) The mastic mix is prepared at the site, and 4) is troweled into place. Patch is feathered out

Type H Starters Give YOU Full Protection



SHORT CIRCUIT PROTECTION

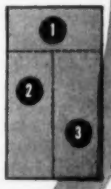
Current-limiting fuse clears short circuit in less than ½ cycle . . . long before the short has had time to harm contactor or motor. Blown fuse emits no gas, flame nor vapor, discharges no metal. Flashover caused by ionized vapor is eliminated.

OVERLOAD PROTECTION

Type 194 thermal overload relay automatically adjusts for ambient temperatures — trips only on motor overload. Prevents unnecessary motor outages. Allows use of maximum capacity, but prevents dangerous motor overloads. Can be adjusted to plus or minus 20% of rated current.

PERSONNEL PROTECTION

The steel cubicle is divided into three compartments for maximum personnel protection. 1 — Upper front compartment encloses disconnect type fuses. 2 — Lower front compartment houses low voltage control devices. 3 — Rear compartment contains high voltage equipment, contactors, buses, intrument transformers, etc.



Side View of Cubicle

TIME DELAY UNDERVOLTAGE PROTECTION

Should an undervoltage occur, the line contactor opens. During a predetermined period, relay remains closed to permit restarting of motors when power is restored.

WHEN YOU SPECIFY Allis-Chalmers Type H starters, you not only get dependable motor control, but you are assured of an all-important "plus"— FULL PROTECTION for man, motor and machine. Positive protection as engineered into Type H starters permits men to work in complete safety... protects motors and machines from costly damage . . . lengthens equipment life . . . increases production by reducing downtime. Get all the facts from your nearby A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin. A-3982

ALLIS-CHALMERS

For more facts circle 542 on Reply Card

OPERATION & PRODUCTION

(O and P begins on page 48)

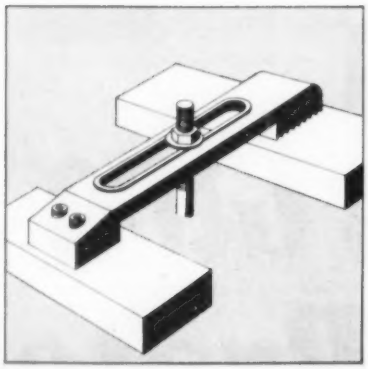
fabrication costs, by eliminating the need for steam or coolant jumpers and flanged joints, except where piping must be disassembled. The method also offers advantages in temperature control (with no concentration of metal at flanges), minimizes thermal expansion and contraction, and provides streamlined flow areas. Insulation is more readily applied to the rounded unbroken surface of the turn.

Clamp Has Non-Slip Features

Contributed by C. H. Willey

DESIGNED FOR USE on a drill press, planer or shaper, a sure-grip clamp features double protection against slippage of a workpiece.

One end of the clamp is serrated and the other drilled and tapped to receive Allen set screws. The serrated end can be used on work that will not be surface-damaged by the serrations, and the set screw end can be used (with the screws retracted, if necessary) on finished surfaces. If required, both non-slip features of the clamp may be used on one job.



Serrations and set screws assure non-slip bite of clamp on metal workpiece

Floor Channels for Service Lines

DEVELOPMENT and recent installation of a service channel system for hangar floors is considered the answer to a long-felt need in hangar-type architecture. At the Fairchild Aircraft Division plant in Hagerstown, Md., service channels for both high and low potential electric service lines, as well as air hoses, are installed as an integral part of the floor.

Six parallel channels are spaced at equal distances, running the entire 250-ft width of the building. This spacing provides flexible service line coverage of the full hangar area.

The hat-type channels, formed from 10-gage steel, are only 1 in. wide at floor level, but are 3 in. wide at the bottom, 2½ in. down. The 1-in. width at floor level permits rolling even small-wheeled vehicles over the open channel.

J. E. Steinhauer, plant operations manager at Fairchild, and designer of the channels, says, "We particularly like the channels because they permit recessing of the 110v, 220v, and 440v electric service cables that usually lie all over hangar floors, at the same time they accommodate air hose and water hose. Heretofore, the conventional hangar had a service trench, which is just as good as the housekeeping it gets, and demands a terrific amount of labor."

Designer J. E. Steinhauer holds cross section of channel above installation

"The channels permit lift trucks, shop mules and other handling equipment to traverse the entire area of the floor without cutting into lines strung over the floor from outlets to work stations."

"Drainage is not a particular problem since periodic cleaning by air hose or industrial vacuum cleaner is adequate. Should a sprinkler system go into action, the heavy floor drains will take off the surplus water and the amount that would stay in the channels could easily be cleaned out with either of the two methods mentioned."

As desired, the channel ends can be slightly elevated to drain in the center, or sloped to the outer walls to empty into drains.

Shallow depth of the trenches obviates collection of gasses in low spots, and the need for explosion-proof equipment, usually found in deep-trench wiring, is removed.

(Continued on page 52)

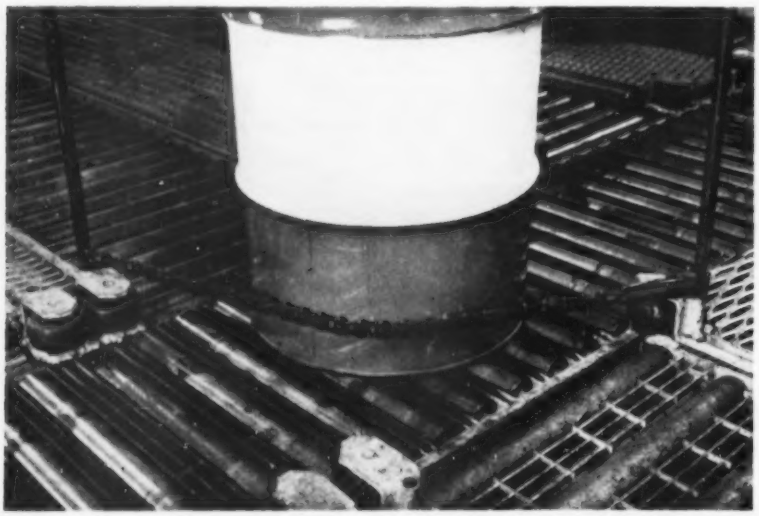
Roller Chain Doubles as Route Selector on Roller Conveyor

DRUM-DEFLECTING at conveyor transfer points gives Esso Standard Oil Co., Bayonne, N.J., different routing possibilities at each intersection of its 144-line drum-handling system.

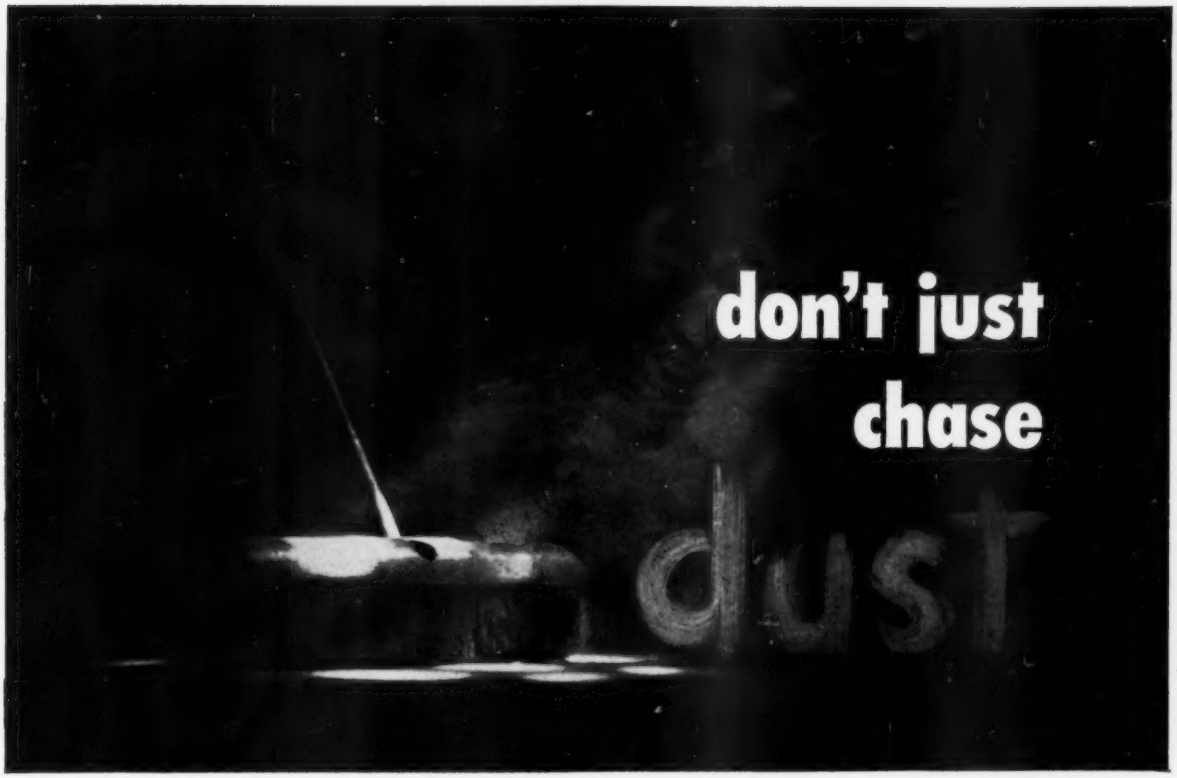
One of several time and labor saving innovations designed by the Lamson Corp., Syracuse, N.Y., for this 3000-filled-drum-capacity storage system is a section of roller chain, with a rod secured at each end. The chain does the deflecting.

Inserting the rods in holes provided at conveyor corners stretches the chain across the conveyor to deflect drums as desired. A spring at one end of the chain absorbs deflecting shocks.

Drums of oil coming from any one of four directions on these reversible conveyor lines can be routed in any one of three directions. Simple repositioning of the rods provides a total of 12 routing possibilities at each conveyor intersection.



Roller chain deflector, anchored at corners of conveyor by rods, turns drum around corner. Repositioning of rods will deflect drum in different direction



. . . eliminate dust with WESTONE!

Dramatic proof of ANTISEPTIC WESTONE'S effectiveness. The hand at left was rubbed across an ordinary untreated section of floor. The hand at right was rubbed over a section which had been treated with dust-controlling ANTISEPTIC WESTONE.

Sweeping only rearranges dust. As a matter of fact, sweeping and floor traffic are the main dust spreaders—not open doors and windows as you might think. And dust is damaging. It spreads many harmful disease bacteria that often cause absenteeism. It affects precision apparatus and delicate finished products. Makes store merchandise, office and institutional floors unsightly.

ANTISEPTIC WESTONE CONTROLS DUST. Loosens and picks it up from floors, bins, shelves, furniture. Seals floor surfaces. Improves their appearance. Holds down subsequent dust so traffic can't raise it. Its antiseptic properties inhibit growth of bacteria.

ANTISEPTIC WESTONE is economical. It works as fast as a man can walk. One man can do the work of three in maintaining floors. And it goes a long way. One gallon covers 4,000 square feet. Interested? Check the coupon.

WEST DISINFECTING Company

42-16 West Street, Long Island City 1, N. Y.

WANT DETAILS?

Tear out this coupon and mail with your letterhead

Dept. 52

I'm interested in:

☐ A FREE leaflet on WESTONE.

☐ A talk with a West expert about my special floor problems. No sales pitch. No obligation. Just discussion and a demonstration if I want it.

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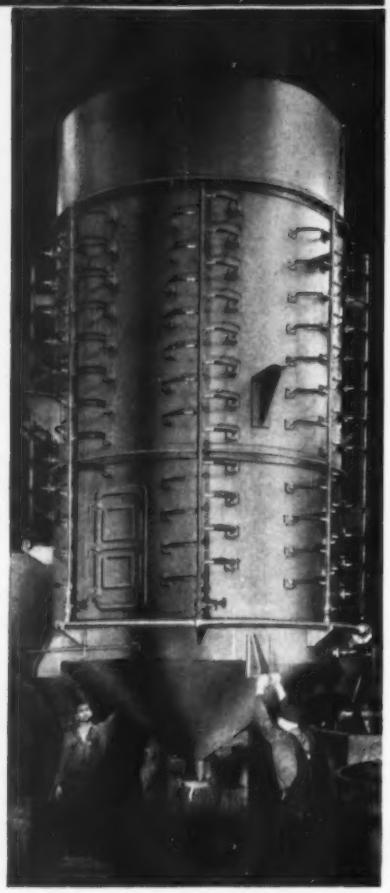
New AIR CLEANING APPLICATIONS
High COLLECTION EFFICIENCY
Low SYSTEM RESISTANCE
Freedom FROM CLOGGING or STICKING
Resistance TO HIGH HEAT, CORROSION and ABRASION

"Buffalo"

HYDRAULIC SCRUBBING TOWERS

This new "Buffalo" wet centrifugal air cleaner solves formerly difficult problems. Its system of closely spaced Fog Type Nozzles creates a fog which jets the air or gas thru the unit, thus overcoming its own resistance. Each layer of fog condenses the one below, permitting gravity travel of the trapped material. This centrifugal spray action, plus scrubbing action against a wetted surface, results in extremely high collection efficiency with no tendency to become clogged, abraded or corroded.



A compact, Easily Installed and Maintained Unit.

Whatever your cleaning problem—gases, dusts, linty or stringy discharges—by all means, investigate this new and trouble-free wet cleaning method. Request new Engineering Bulletin AP-525, on your company letterhead.

First For Fans

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166 MORTIMER ST. BUFFALO, NEW YORK

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING
FORCED DRAFT COOLING HEATING PRESSURE BLOWING

For more facts circle 544 on Reply Card

OPERATION—PRODUCTION

(O and P begins on page 48)

Block Holds Impact Tools for Test

Contributed by Anton Dotzauer
Allis-Chalmers Manufacturing Co.

Air-operated impact tool is inserted into test block to evaluate repairs

IN THE TOOL REPAIR shop at Allis-Chalmers, it was the practice to test repaired impact tools by inserting the shank in a vise to hold the tool as the air was turned on. Using this method, the repairman could check the tools for approximate efficiency and also determine their working condition after repair.

A test block has been devised to simplify this testing and eliminate the necessity of clamping the tools in a vise. Inserting the tool shank into the proper-size slot in the block, the repairman can test the tool in an easily-controlled position. The weight of the block is sufficient to prevent its movement as the air pressure is applied to the tool.

Die Preforms Field Coils

FITTING REPLACEMENT coils into electric motors can be a tedious task, and the use of a jig provides considerable relief for the repair man.

Although most coils are manufactured with a curvature, final fitting into the motor often requires considerable pressure on the tightening screws. This excessive strain can lead to displacement of coil laminations in the area of the screws, and resulting misalignment of the poles.

Constructable from parts of an old motor, a die can be fabricated to provide proper fit without excessive strain on the motor being repaired. A longitudinal section of an old motor frame is welded to a base plate to become the female part of the die. The male part is a laminated field pole, mounted on a section of

BUILT LIKE A BRIDGE FOR

Rough Tough Service

New GOULD DIAMOND "Z" GRID

Specify
The GOULD "THIRTY"
Now, more than ever,
America's Finest
Industrial Truck Battery!

Look at this illustration of Gould's new Diamond "Z" Grid. See the bridge-type construction—the husky diamond shaped active material retaining members. Note the *extra* large conductive members which not only conduct current to the lug with high efficiency but give still more strength to this most recent achievement of the famous Gould Laboratories.

Here's a grid that's built for rough, tough service, top performance and long life. Years ahead of requirements, it has *extra* strength for every application, *extra* ruggedness to withstand abuse, *extra* ability to deliver full power longer. Now more than ever—when you buy, buy Gould!

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Trenton 7, N. J.

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When you have a packing problem . .

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Rhoads offers you sound engineering advice on the selection, application and installation of Tannate Leather Packings. This is based on Rhoads' long experience custom-manufacturing packings to fit-the-job and on the results of countless installations.

A Rhoads Direct Factory Representative will discuss your problems with you and show you how the application of Tannate Leather Packings can provide long, uninterrupted production, reduce replacements and result in more pieces produced per hour. Tannate Packings have these features: low co-efficient of friction; do not cold flow; will not score or abrade; require no lubrication.

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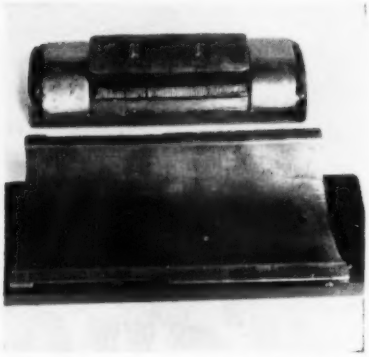
OPERATION—PRODUCTION

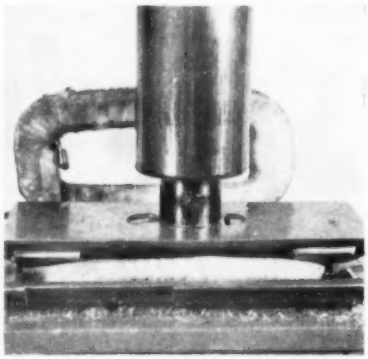
(O and P begins on page 48)

bar stock of diameter equal to that of the armature being repaired. Additional pieces added at the ends of the male die exert pressure on the coil ends to assure their positioning.

Now, coils preformed on the die can be installed in the motor with less tension on the pole piece screws. Ease of installation is beneficial to the motor laminations and their alignment, as well as to repairmen.



Die halves separated to show construction. The male half (top) is inverted



Die and coil in position under press to form coils prior to installation in motor

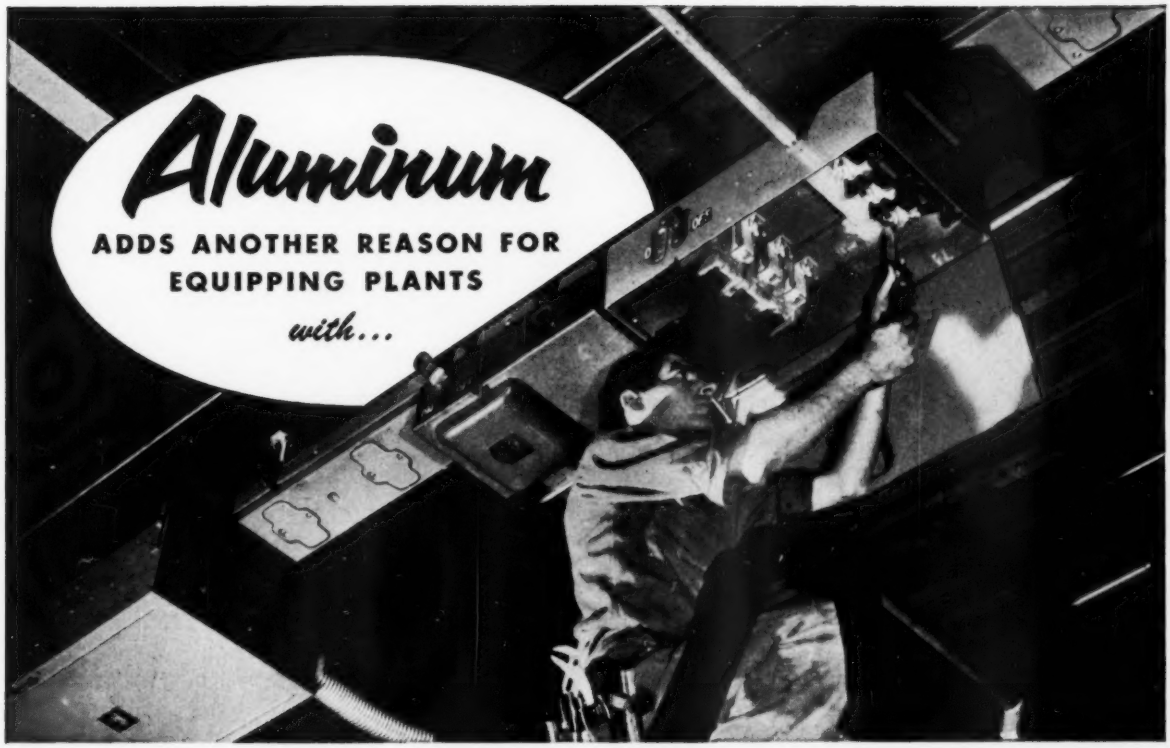
Clamp Serves as Lifting Tool

Contributed by Roy F. Smith
Allis-Chalmers Manufacturing Co.

HANDLING of unwieldy blade ring sections, usually done with a rope or cable sling from an overhead hoist, is much easier following the adaptation of a C-clamp to grip the pieces.

Developed to handle the sections for insertion into a boring mill, the device consists of a 12-in. C-clamp with a 10-in. length of 2-in. bar stock welded to the upper jaw. Holes drilled at 2-in. intervals along the bar are tapped for insertion of an eyebolt.

With the clamp tightened in posi-



FLEX-A-POWER

Busway Distribution Systems

FLEX-A-POWER means permanent modernity of a building's electrical distribution system — complete freedom to change layout, add or move equipment, rearrange circuits and make building additions at minimum cost. Hundreds of modern plants have adopted it.

Now *Aluminum* Flex-A-Power gives you all the advantages of copper Flex-A-Power, including low voltage drop, *with up to 35% less weight.*

This means easier handling and installation, less expensive hanging, lighter floor loading.

Now the margin of Flex-A-Power superiority is greater than ever. Your Trumbull Distributor, working with Trumbull engineering, can give you authoritative information, prompt quotations and speedy delivery. Call him, or write us for Bulletin TEC-21.

Quick Facts ABOUT *ALUMINUM* FLEX-A-POWER

***TYPE FVK.** A plug-in busway with power outlets at one-foot intervals, tapped by Flex-A-Plugs of the fusible switch or molded case circuit breaker types. 225-800 amperes, to 600 volts. (3-phase 4-wire 277/480 volt type available in 225 and 400 ampere ratings.)

***TYPE LVD.** For high capacity, low voltage drop, feeder applications, or as a riser in multi-story buildings carrying high currents over long distances, 600-4000 ampere ratings, to 600 volts.

*Also available with copper bus bars. Light- and heavy-duty trolley busways available with copper bus bars only.

Listed by Underwriters' Laboratories, Inc.

GENERAL ELECTRIC

DISTRIBUTION ASSEMBLIES DEPARTMENT
PLAINVILLE, CONN.

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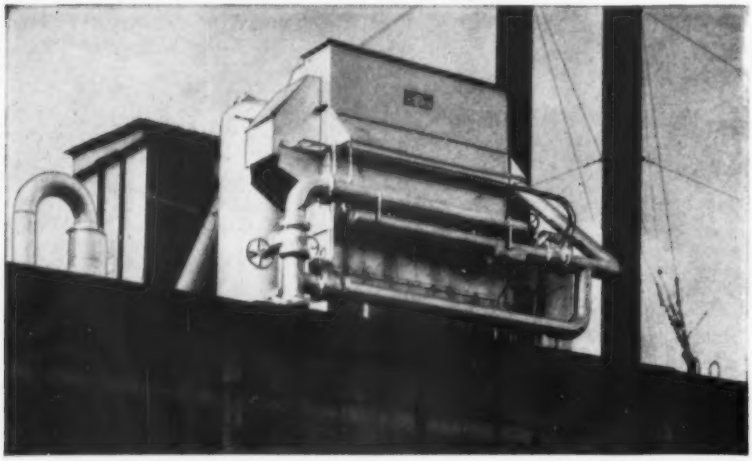
Direct saving of cooling water expense returns to you the cost of a Niagara Aero After Cooler in less than two years.



How to Get Drier Compressed Air:

It prevents many troubles and saves much expense

● NIAGARA AERO AFTER COOLER cools compressed air or gas below the temperature of the surrounding atmosphere. Therefore you get no further condensation in your lines. You save much in repairs to pneumatic tools and equipment; you save much interruption to production; you save water damage in paint spraying, in air cleaning, in any process where compressed air comes in contact with your materials or parts in manufacturing (sand blasting, for example).

Niagara Aero After Cooler uses evaporative cooling, saving 95% of your cooling water consumption. This saving quickly returns the cost of the equipment to the owner or makes extra cooling water available for other processes.

The Niagara Aero After Cooler produces compressed air with 30% to 50% less moisture than by ordinary cooling methods. Other Niagara equipment provides bone-dry air for processes requiring it.

If you have an air problem or a cooling problem, a Niagara engineer probably has an answer that will improve your process or save you operating or maintenance expense.

Write for Bulletin 98

NIAGARA BLOWER COMPANY

Over 35 Years Service in Industrial Air Engineering

Dept. PE, 405 Lexington Ave. New York 17, N. Y.

Experienced District Engineers in all Principal Cities of U. S. and Canada

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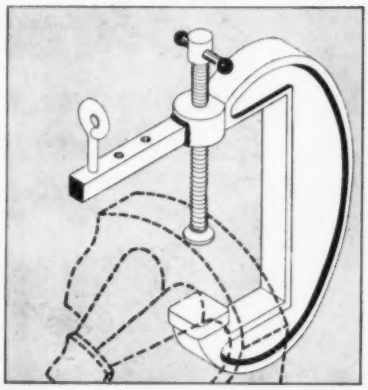
OPERATION—PRODUCTION

(O and P begins on page 48)



Modified C-clamp uses length of bar stock as a handle to lift workpiece

tion on the work piece, the barstock acts as a handle, and the position of the eyebolt can be regulated to place it over the center of gravity of the workpiece. Variance in blade section sizes is easily offset by moving the eyebolt position along the bar stock handle.

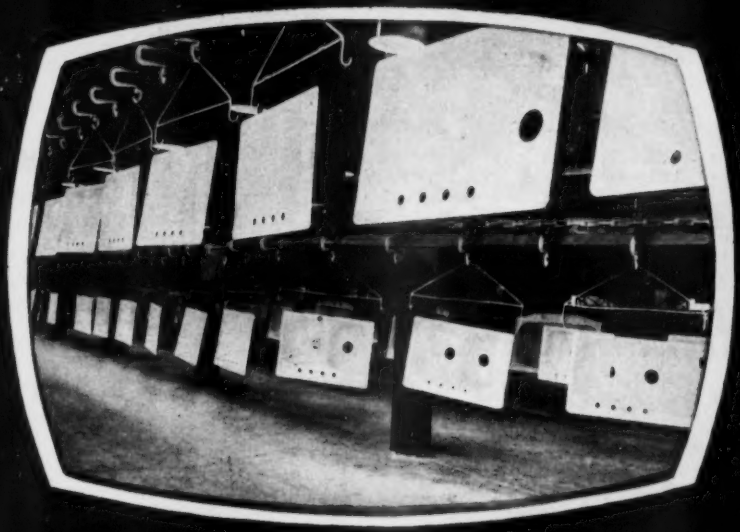
Corner Cutter Trims Sheet Metal

TOOL ENGINEER Wesley Lund, of Boeing Aircraft, has come up with a tool that literally and figuratively "cuts corners" in the plant sheet metal bench and trim department.

Expected to save approximately $6500 per year, the new cutter trims corners on photo template sheets twice as fast as the formerly used hand-operated arbor press. It can shear metal as tough as 0.090 annealed stainless steel at a total

Operator holds corner cutter in position to trim corner from photo template

telling the story of 'dag' dispersions



Are You Getting Proper Results From Your Present Lubricant?

Does your present lubricant adhere to, and become an integral part of, all friction surfaces that move in high temperature? Does it possess almost unlimited durability? Does it provide protection at extreme temperatures to such things as bearings of kiln-car wheels, to oven conveyors, and other devices and appliances which are exposed to burning heat or freezing cold?

If your present lubricant cannot fulfill these varied requirements, then consider one which does: **'dag'** Colloidal Graphite, the ideal *dry-film lubricant.*

Dispersions of **'dag'** Colloidal Graphite in oils, water, volatile hydrocarbons, and resin-solvent combinations give you slick, durable, dry lubricating films. Applied by spraying, painting, or dipping, they won't gum up or break down *at any temperature you are likely to encounter.*

Learn how this versatile lubricant can help you. Write *today* for Bulletins **No. 424-22M and No. 435-22M.**

Dispersions of molybdenum disulfide are available in various carriers. We are also equipped to do custom dispersing of solids in a wide variety of vehicles.

dag DISPERSIONS

Acheson Colloids Company, Port Huron, Mich.
... also ACHESON COLLOIDS LIMITED, LONDON, ENGLAND
Units of Acheson Industries, Inc.

try 'dag' resin-bonded dry films for permanent lubrication

HERMETICALLY SEALED
TIME ELEMENT

Silic-O-Netic
TIME DELAY
RELAYS

. . . only one moving part

The simplest time element ever developed for electrical equipment is the basis of the new SILIC-O-NETIC Time Delay Relay. There are no heating elements . . . no gaskets . . . no levers . . . no mechanical connection to the armature, yet the time element forms the very heart of the relay itself.

Being hermetically sealed, the SILIC-O-NETIC element is forever free from the effects of dirt, dust or adverse atmospheres. Employing silicones, timing is positive and unaffected by normal ambient temperature changes.

YOUR PRODUCT can have the long life dependability of SILIC-O-NETIC Time Delay performance . . . at low cost.

Complete information is available upon request. Write for Bulletin 5001.

BRIEF FACTS

SMALL SIZE . . . overall relay size only 1⅜" x 2½" x ¾".
DELAY PERIODS . . . up to 4 minutes.
A LOAD CARRIER IN ITSELF . . . usually eliminates the need for auxiliary load relay.
LONG LIFE DEPENDABILITY . . . tested into millions of operations.
LOW COST . . . achieved in 20 years of solenoid manufacturing experience.

HEINEMANN ELECTRIC COMPANY

128 Plum Street, Trenton 2, N. J.

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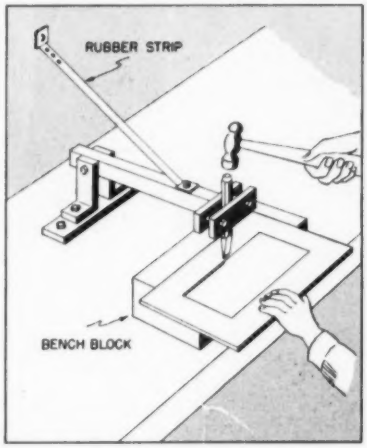
OPERATION—PRODUCTION

(O and P begins on page 48)

shearing load of 7,020 lb, and can cut holes of any shape and size (up to 5 in. in diameter) in ⅛-in. Fiberglas and Micarta without the use of a stripper.

Mechanic's "Third Hand"

Contributed by C. H. Willey



Pivoted tool holder provides extra hand for mechanic in cutting or swaging work

FABRICATED from bar stock, a pivoted tool holder provides a helping hand to the mechanic who is cutting, forming or swaging. The horizontal arm has a tool clamp welded at its end to grip the tool, and tension to raise the tool above the work after each blow is provided by a strip of rubber or a spring.

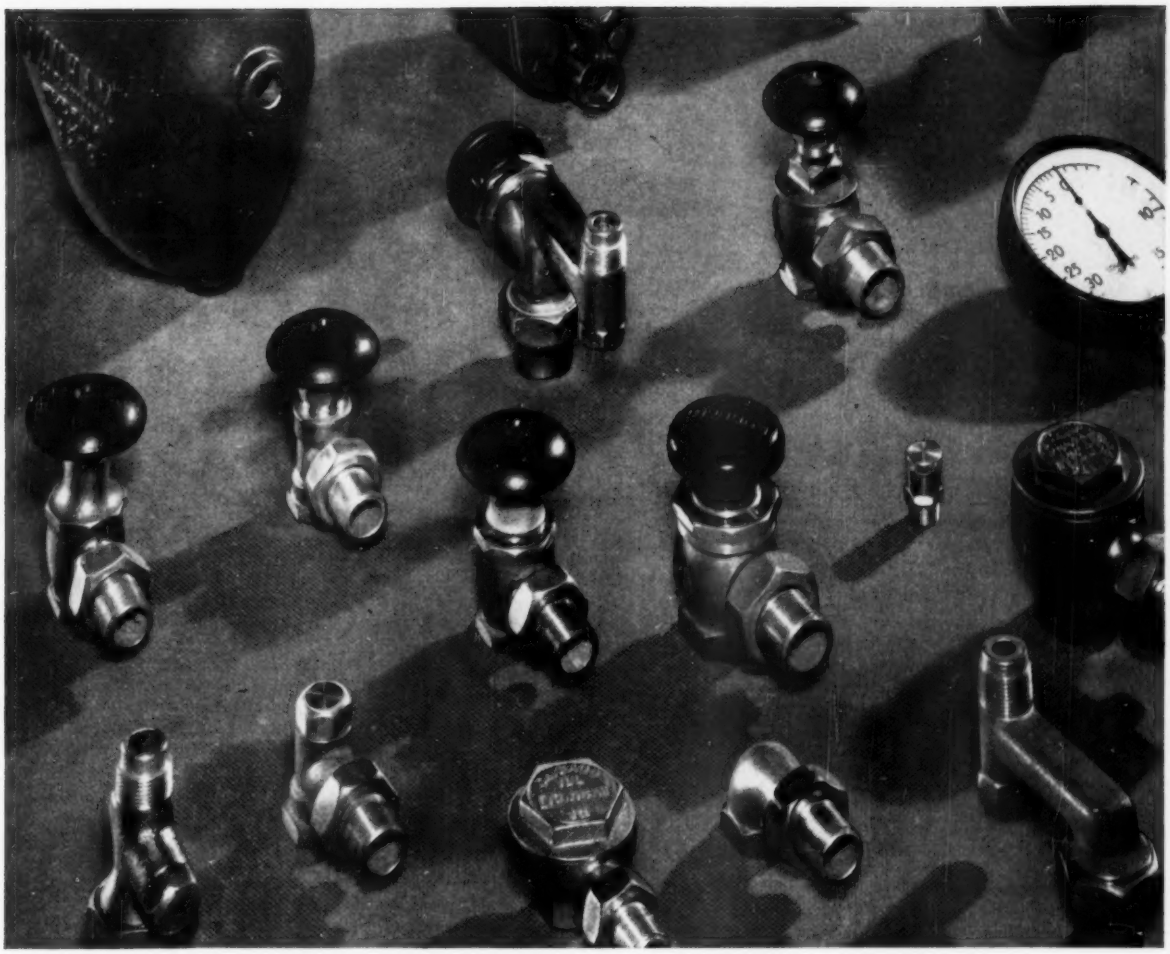
Hot Suit for Drivers

POWERED by the same battery that turns the wheels of his truck, a heated suit keeps the truck driver warm at the cold storage plant of the Modesto Refrigerating Co., in California.

Originally flight suits produced for the Air Force, these suits permit the truck operator to work for extended periods in cold storage warehouses.

Photo: Gould-National Batteries, Inc.

Truck operator plugs suit into rheostat that controls battery-to-suit current



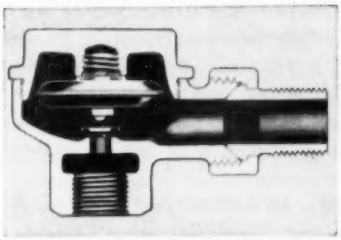
IT'S PROBABLY RIGHT ON THIS PAGE...

Every Steam Heating Specialty You Need is probably in the Dunham line, represented in the photo above. After all, Dunham's Specialties line is as complete as you'll find . . . *anywhere.* Every item has design features that mean better heating performance.

Dunham Radiator Traps, for instance, have an extra large, non-clogging valve seat opening—not restricted by a guide—that assures easy passage of air, water, foreign matter. Dunham's monel metal thermostatic disc has stop shoulder construction for easy individual calibration when servicing traps in the field, also allows thermostatic disc to be set at the factory to assure correct operation without field adjustments.

Sealed under high vacuum, Dunham's thermostatic disc assures positive response to temperature and pressure changes . . . *no bellows to clog or stick.* Disc corrugations distribute motion uniformly with minimum strain, no vibration.

For all the facts about Dunham Radiator Traps and other Heating Specialties, clip and mail the coupon.



Dunham No. 1E Radiator Trap in 3 sizes; 6 patterns; capacities from 200 to 700 EDR.

DUNHAM HEATING SPECIALTIES

RADIATION • UNIT HEATERS • PUMPS • SPECIALTIES

QUALITY FIRST FOR FIFTY YEARS

C. A. DUNHAM COMPANY • CHICAGO • TORONTO • LONDON

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Send Heating Specialties Literature.

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City_____ Zone____ State____

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EXPLOSION PROOF

SUN OIL CO., MARCUS HOOK, PA., 3000 lb. Air Palletier, equipped with 12″ side shifter, stacks pallet loads in ship's hold. Models also available in 2000 and 4000 lbs.

CRESCENT air operated PALLETIER

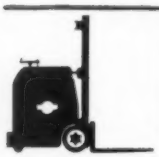
Air Palletier, another first developed through Crescent JOB ENGINEERING, eliminates the principal cause of explosions because there are no electrical devices...no motors, contactors, or resistors. The drive unit and hydraulically operated lift mechanism are powered by air motors. Air is supplied either from a compressor (located outside the danger zone) or from piped air when used within the plant. A spring-loaded reel carries sufficient hose length to provide 75 feet of operating radius. When piped air outlets are available, operating area can be increased up to 200 feet, or more.

Pricewise, Air Palletier costs considerably less than special type so-called "explosion proof" electric trucks.

For maximum safety—specify Crescent Air Palletier. Complete specification literature sent promptly upon request.

Our 36th Year

INDUSTRIAL TRUCKS FOR EVERY USE



AISLE-SAVER. Stand-up Model. Extremely Maneuverable. 1000 to 4000 lbs.

LOW HEAD-ROOM MODEL. For highway truck loading and unloading. 2000 to 4000 lbs.

HIGH-LIFT PLATFORM. Telescopic—4000 to 6000 lbs. Non-telescopic—4000 to 10,000 lbs.

LOAD CARRIER. Heavy-Duty utility truck. 4000 to 10,000 lbs.

TRACTORS. For trailer towing. For all trailer train loads.

LOW-LIFT PLATFORM. For lifting and moving skids. 1000 to 10,000 lbs.

CRESCENT TRUCK COMPANY
Division of Barrett-Cravens Co.
1045 Willow Street
LEBANON, PENNSYLVANIA

CRESCENT EXPLOSION PROOF AIR PALLETIER

For more facts circle 552 on Reply Card

COURT DECISIONS — a summary of legal findings of interest to the plant engineer

Prepared by Albert Woodruff Gray

Loss By Explosion

A building and its contents in St. Louis, Missouri, were insured against a loss by fire with the condition in the policy, "If the risk shall be increased by any means whatever or if such building or premises shall be occupied in any way so as to render the risk more hazardous than at the time of insuring," the policy should be void.

The building had been closed for the night with one gas jet burning. In the building were gasoline and coal oil. Four hours after the building was closed there occurred a terrific explosion demolishing the building and followed by a fire.

In the action brought to recover on this policy the insurance company contended that the presence on the premises of gasoline and coal oil served to void the policy—that the insurance was against loss by fire, not by explosion.

In affirming a judgment against the insurance company the Missouri Supreme Court said, "The buildings were damaged or destroyed by fire if a fire of some description upon some part of the premises insured was the original cause of the loss, although such a fire was followed by an explosion which was itself the direct result of the fire and brought about the fall of the buildings.

"If the fall of the buildings was the direct result of some burning substance in contact with some part of the building, it is immaterial whether such result manifested itself in a fire or combustion or of explosion or of both combined. In either case the damage which ensued was by the action of the fire and is covered by the terms of the policy.

"We are of the opinion," concluded the court, "that the loss was covered by the policy whether the fire was started from a box of matches and was gradually communicated to the oil or gasoline, or whether directly communicated from the gas jet."

Purchased Goods Destroyed Before Delivery

The purchaser of a 16 in. six spindle machine agreed under a purchase contract to pay $25,000, with a down payment of $4,000 and the balance in ten days. The buyer had requested however, in this purchase order, "We would like you to hold the machine for a week or two as we may sell it direct from your plant," to which the seller agreed.

At the end of ten days the balance had been paid with the request for a further delay in shipment. "The reason for trying to phone you was to ask if it would be possible to leave the machine in its present position for another week or two." Four days later the machine was completely destroyed by fire while still in the seller's possession.

A lawsuit was brought by the purchaser to recover the $25,000 paid under this agreement. In its decision the trial court held that the machine was the property of the purchaser who must bear the loss.

"There is no rule better established both by the law of England and in this country than that the sale of a specific chattel passes the right of property to the buyer with a delivery of possession. And ordinarily where no further act remains to be done to identify the property sold or to ascertain the quality or quantity and the price has been paid and the buyer entitled to take immediate possession, the title will be deemed to have passed though there has been no actual taking of possession by the buyer."

Insurance Recovery Sustained

An abrasive wheel made by another manufacturer and installed in a pneumatic grinding machine was sold with a salesman's repre-

sentation that the machine was not dangerous to use.

The wheel flew apart and the manufacturer was compelled to pay $11,500 in settlement of the action brought by the injured man. The manufacturer was insured against "all operations during the policy period which are necessary or incidental thereto," except for accidents that occur "after such operations have been completed."

When suit was brought by the manufacturer against the insurance company to recover this loss the insurance company claimed in its defense that the representations of the salesman that the wheel was safe was an operation that was completed when the accident occurred and as a consequence the loss was not covered by this policy.

In ruling against this defense the United States Court of Appeals said, "To answer in the affirmative would result in relieving the insurance company from any liability. A representation made for the purpose of or reasonably calculated to induce action is not completed until the person to whom the representation is made acts in reliance upon that representation."

Betrayal of Trade Secrets

The manufacturer of aircraft engines applied to a New York Court for an injunction against the disclosure of a secret process for the bonding of aluminum and steel, which had been entrusted in confidence to a former officer and director of the company.

After the relations between this manufacturing company and its director had ended, this former director entered the employ of a competitor with the purpose of using his knowledge of this secret process in competition with the company with which he was formerly associated.

In granting an injunction against the disclosure of this trade secret the court said,

"Unless otherwise agreed an agent is subject to a duty to the principle not to use or communicate information confidentially given him by the principle or acquired by him during the course of or on account of his agency or in violation of his duties as agent, in competition with or to the injury of the principle, on his own account or on behalf of another, although such information does not relate to the transaction in which he is then employed, unless the information is a matter of general knowledge.

"After the termination of the agency the agent is subject to a duty to the principle not to use or disclose to a third person on his own account or on account of others, in competition with his principle, or to his injury, trade secrets, written lists of names or other similar confidential matters given to him only for the principle's use or acquired by the agent in violation of duty. The

COURT DECISIONS

agent may use general information concerning the methods of business of the principle and the names of customers retained in his memory, if not acquired in violation of his duty as agent."

This statement of the law the court supplemented with a quotation from a decision of a Federal appellate court in relation to a die rolling process that had been entrusted in confidence to employees who were subsequently hired by a competitor.

"The law unquestionably affords relief to one injured in such a situation since fraudulent deceptions and injury to the good will of established or prospective business or enticement of employees to abandon their employment and enter the service of another to insure producing the same article and thus gain an advantage in the same business by devising means and obtaining the same trade in a particular industry, are acts against which redress is provided.

"There is plentiful legal authority for holding that such conduct is grossly inequitable and consequent injuries either to vested or prospective property rights may be relieved.

"While an employee has an undoubted right if he can do so without the violation of a contractual undertaking with his employer, to withdraw from the employment and to enter into a similar business on his own account, this natural as well as legal right does not entitle such withdrawing employee without the knowledge, consent and approval of his employer, to take with him for his subsequent personal use and profit any property or property right of his employer during the time of his employment.

"In such a case there is an implied contract arising from the confidential employment that the employee shall not use, except for the purpose of service, the opportunities which that service gives him of obtaining information."

Order for Electric Current

An order of the Public Service Commission of Utah directed an electric utility in that state to supply energy adequate for the use of a specific consumer. This the utility refused to do, contending that the Commission's order constituted the taking of property without due process of law in violation of both the United States and the Utah State Constitutions.

Refusing to grant an injunction against the Commission on the application of this utility, the Utah court said,

"Although this consumer is not subject to supervision or regulation by the Public Service Commission, that is not true of this utility and the Commission acted within its powers in ordering that company to serve the type of customer within its territory which it has professed to serve.

"The energy, according to the Commission's order, is to be sold within the territory served by the utility and not elsewhere. This consumer is to receive the power there and once this energy has entered the transmission line belonging to the consumer it becomes the property of the consumer and the utility has no further concern about it.

As to the agreement under which this purchase of energy is to be made, it will be subject to the supervision and regulation of the Commission because the utility and the contracts into which it enters are subject to such regulation regardless of who the other party to the agreement may be."

Injury from Truck

A refinery truck was traveling between 15 and 20 miles an hour on a 22 ft concrete highway between

Baltimore and Annapolis, Maryland. Nearly 850 feet ahead, a motor cyclist stood at the side of the road until the truck was within 40 ft when he attempted to cross to the other side.

The driver brought the truck to a standstill but the front bumper hit the side of the motor cycle, overturning it onto its owner. In affirming a judgment denying a recovery in the action brought against the refining company for negligence the court asserted,

"Where a pedestrian is standing in a highway and does not notice the approach of an automobile the driver should avoid striking him if possible by turning aside where there is ample room to pass the pedestrian in safety.

"On the other hand where a pedestrian sees an approaching automobile and the traffic lane is so narrow that one or the other must move outside of it in order that the car may pass, the pedestrian ought to allow the car to proceed without turning aside and going around him.

"It is well established that where a pedestrian suddenly steps into the path of an approaching car and he either does not look to see if any car is approaching or makes no effort to avoid it by stopping or stepping aside, although he could easily have seen it in time to have kept or taken a position of safety and thus avoided the accident, he is guilty of contributory negligence as a matter of law, precluding recovery for resulting injuries."

Authority for Zoning Ordinance

The zoning ordinance of a New York State village divided the territory into two districts, residential and business. An action was brought to declare the ordinance void.

"It was insufficient," said the court of this action in its decision "for the protesting property owner merely to show that the property could be more profitably or more beneficially used for industrial than residential purposes."

The rule in this state that limits the zoning power of municipalities in the adoption of these ordinances, was outlined a quarter of a century ago in a decision of the Court of Appeals of that state in an instance in which a property owner had protested that the zoning restrictions prevented the use of his property for any permitted purpose since the land had been restricted to residential purposes and was adjacent to a city operated sewage incinerator.

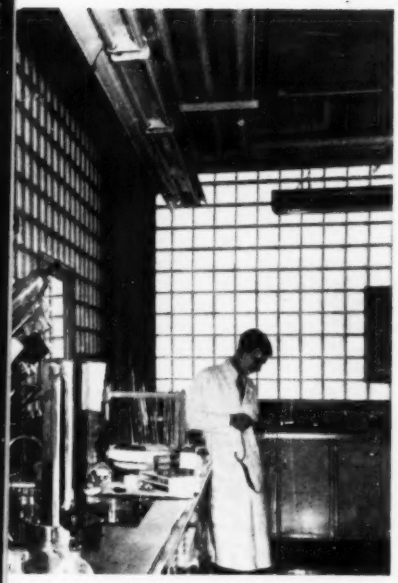
"We may assume that the zoning ordinance is the product of farsighted planning calculated to promote the general welfare of the city at some future time," said the court setting aside in that case the ordinance. "If the state or the city had plenary power to pass laws calculated to promote the general welfare then the validity of the ordinance might be sustained for we have nothing to do with good policy.

"The legislative power of the state is however, not plenary but is limited by the Constitution of the United States and by the Constitution of the State. It may not take private property without compensation even for a public purpose and to advance the general welfare. The protection of private property in the Fifth Amendment presupposes that it is wanted for public use but provides that it shall not be taken for such use without compensation.

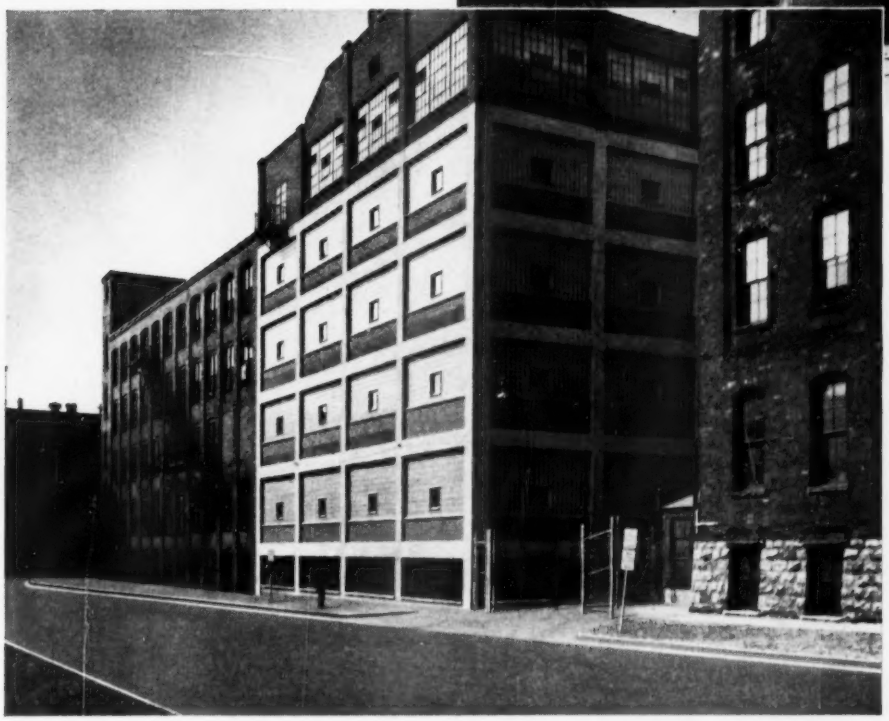
"When this seemingly absolute protection is found to be qualified by the police power the natural tendency of human nature is to extend the qualification more and more until at last private property disappears. But that cannot be accomplished in this way under the Constitution of the United States."

Before Daylight Engineering

(deteriorated sash plus high maintenance costs)

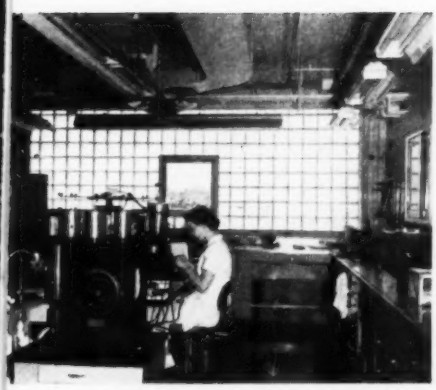


Control of room conditions is vital in the performance of critical laboratory experiments. Because of the excellent insulating properties of Insulux Glass Block, temperatures within each laboratory are easier to control



After Daylight Engineering

(A pleasant, cheerful atmosphere and no maintenance)



Abundant daylight is brought into the laboratories at all times of the day. And, because glass block has little affinity for dirt and dust, hospital-clean conditions prevail

When the Upjohn Company, Kalamazoo, Michigan, transferred its pharmaceutical manufacturing operation to a new plant, it was decided to convert this 30-year-old building into laboratories devoted to the study of Pharmacology and Endocrinology.

One of the first problems that had to be solved was what to do about sash replacement. The original sash had deteriorated so badly it took continual, expensive maintenance to provide proper weather protection.

Since all of the laboratories were to be air-conditioned, Insulux Glass Block® was selected because it promised savings in operating expenses as well as economical installation costs. The glass block modernized the entire building exterior and brought it up to date, despite the actual building age.

If you are in the process of remodeling old structures or building new ones, don't overlook the positive advantages that panels of Insulux Glass Block bring. An experienced Daylight Engineer is ready to help you with your plans. Write Insulux Glass Block Division, Kimble Glass Company, Dept. PE-12, Box 1035, Toledo 1, Ohio.

KIMBLE GLASS COMPANY

Toledo 1, Ohio—*Subsidiary of Owens-Illinois Glass Company*

For more facts circle 553 on Reply Card

USE

MonoRail CRANES

. . . Where Space is Limited

. . . To Handle Variable Jobs

. . . For Low Maintenance Cost

These are just a few reasons why American MonoRail Cranes are gaining in popularity and are being installed in increasing numbers of plants the country over. Call in your American MonoRail representative and have him tell you all the advantages of MonoRail Cranes such as—ease of handling—smooth travel—strength—safety interlocks—power operation and **interlocking carrier service between and beyond the craneways.** Consultation in connection with any handling problem is available without obligation.

Send for your copy of C-1 Bulletin

AMERICAN OVERHEAD HANDLING EQUIPMENT

MonoRail COMPANY

13123 ATHENS AVENUE • CLEVELAND 7, OHIO

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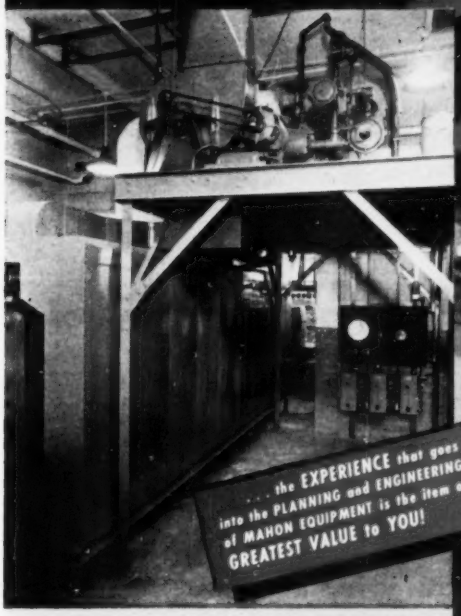
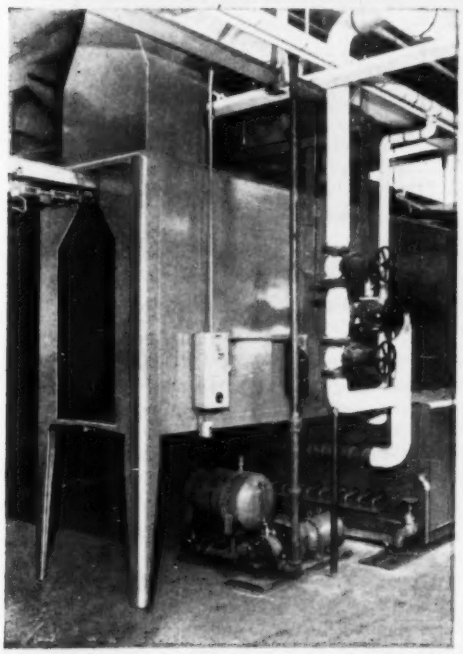
COMPLETE *Finishing* SYSTEMS

. . . for ENAMELS • LACQUER • PAINT • VARNISH



Mahon Low Temperature Finish Drying Oven at American-Standard. View shows Heating, Recirculating and Exhaust Equipment as well as the Control Cabinet Housing Temperature Controls, Recording Instruments and Safety Devices.

View of One of Two Complete Mahon Finishing Systems Installed in the Buffalo Stamping Plant of American-Standard. Metal Cleaning and Rust Proofing Machine and Dry-Off Oven are in the Foreground.



Exit End of Mahon Metal Cleaning and Rust Proofing Machine at American-Standard. Processing Solutions are Heated by Steam. Temperature Control is Automatic.

HEATER PANELS at AMERICAN STANDARD are also FINISHED in MAHON EQUIPMENT!

Major elements of a second Complete Mahon Finishing System installed in the Buffalo Stamping Plant of American-Standard are illustrated here. This second system, like the other, is ultramodern in every respect. Parts are carried on a single conveyor which passes through a five-stage Metal Cleaning and Rust Proofing Machine, a Dry-Off Oven, a Cooling Tunnel, two Conventional Type Hydro-Filter Spray Booths which are staggered right and left hand, for spraying opposite sides, and finally through a Low Temperature Finish Drying Oven. This is another typical Mahon Finishing System designed to do a specific job efficiently and economically. If you have a finishing problem, or are contemplating new finishing equipment, you will find that Mahon engineers are better qualified to advise you on both methods and equipment requirements . . . better qualified to do the all-important planning, coordinating and engineering of equipment—which is the key to fine finishes at minimum cost. And, you will also find that Mahon equipment is built better for more economical operation over a longer period of time. Mahon's background history in this highly specialized field covers thousands of Complete Finishing Systems including Dip, Flow Coating and Spray Equipment for every conceivable product painted on a production basis. See Mahon's Insert in Sweet's Plant Engineering File, or write for Catalog A-654.

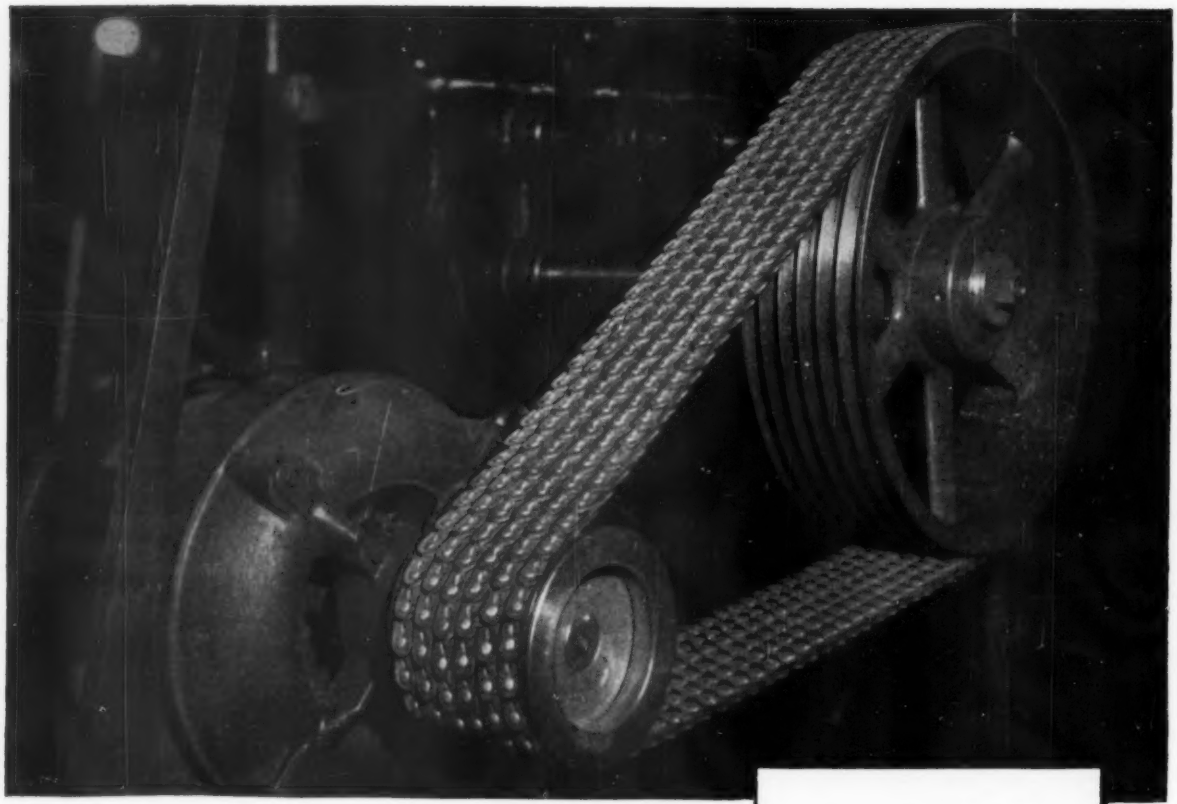
THE R. C. MAHON COMPANY

HOME OFFICE and PLANT, Detroit 34, Mich. • WESTERN SALES DIVISION, Chicago 4, Ill.

Engineers and Manufacturers of Complete Finishing Systems—including Metal Cleaning, Pickling, and Rust Proofing Equipment, Hydro-Filter Spray Booths, Dip and Flow Coaters, Filtered Air Supply Systems, and Drying and Baking Ovens, Coating Tunnels. Heat Treating and Quenching Equipment for Aluminum and Magnesium, and other units of Special Production Equipment.

MAHON

For more facts circle 555 on Reply Card



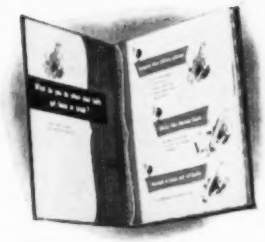
with Veelos on your machines...

v-belt adjustment is a production-saving job

All v-belts stretch—but with endless v-belts there's nothing you can do to take up this stretch once the motor has been completely "run-out". With Veelos it's another story! The adjustment is in the belt itself—even sliding motor bases are unnecessary.

Changing the length of each Veelos v-belt by just adding or removing links is the best, most efficient, way to keep the belts correctly matched. Using Veelos means that the job of adjustment is done easily and quickly . . . at a fraction of the cost of replacing with new belts.

Veelos, the adjustable v-belt, provides vibrationless, full power delivery. It is easier to stock and control because it is packaged on 100-foot reels in every standard width. And Veelos can be adjusted or made up in correctly matched sets with the least amount of machine down-time—at production-saving speed!



Have you seen this Veelos Facts Book?

Your Veelos v-belt distributor's salesman will be glad to give you a quick trip through this fact-packed, 36 page book. You'll find it well worth the few minutes it takes. Next time the salesman calls, ask him to show it to you.

VEELOS
THE LINK
V-BELT

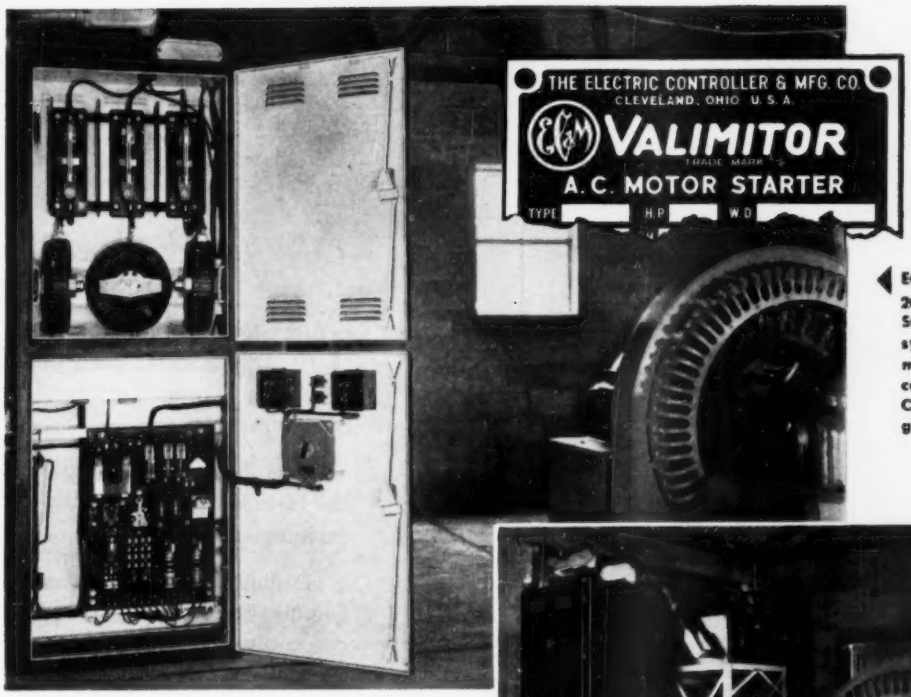
Write today for your copy of the Veelos Data Book—it is a completely illustrated, 28-page catalog that gives file-worthy product and engineering facts which you should have handy. We'll be glad to send you a copy at once.

MANHEIM MANUFACTURING AND BELTING COMPANY
652 Manbel Street, Manheim, Penna.

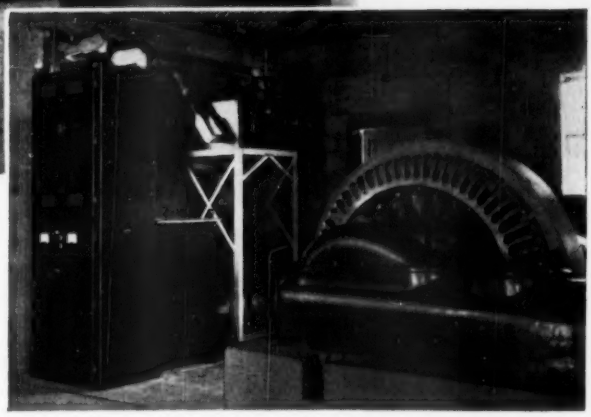
ADJUSTABLE TO ANY LENGTH • ADAPTABLE TO ANY DRIVE

For more facts circle 556 on Reply Card

4-WAY PROTECTION for "essential" drives



EC&M 4160 Volt 200 HP VALIMITOR Starter for new synchronous motor-driven air compressor in Central Ohio glass plant.



1 SHORT CIRCUIT Protection—KVA availability may be infinite—VALIMITOR (Volt-ampere-limitor) coils limit fault currents to 25,000 KVA. Type ZHS Contactor, with interrupting capacity of 50,000 KVA plus the d-c component, clears the circuit quickly.

2 MOTOR PROTECTED from overheating due to single phase operation or from overload when running. If motor pulls out of step and then re-accelerates the load, re-synchronization again occurs automatically.

3 UNDER VOLTAGE Protection—on momentary voltage dips, time-delay keeps push button circuit "active," eliminating necessity to re-press the start button if voltage recovers in two seconds or less. Contactor held in under full contact pressure down to 25% of normal voltage, then breaks cleanly. Avoids contact sticking under weak spring pressure.

4 PERSONNEL Protection—complete enclosure with hinged upper and lower doors on front cubicle. Upper compartment contains high voltage with electric door-interlock to open contactor circuit. Low voltage apparatus in lower compartment.

They couldn't afford a shut down. This essential "main-line" drive supplies air for the production of glass. Plant management found EC&M VALIMITOR Starters offered the best guarantee for continuity of service. No fuses to replace on a fault. The time-delay UVP feature was simple and the contactor held in down to a low voltage on a momentary voltage dip. The Type ZHS Contactor combined high interrupting capacity with ability to provide repetitive starts and stops with only routine inspection.

When making initial cost estimates, get the facts on EC&M High Voltage Starters. Our nearby office will be glad to supply full information on 2300-5000 volt starters which give complete protection.

write for bulletins 1062 and T9-117

THE ELECTRIC CONTROLLER & MFG. CO.
2698 EAST 79TH STREET • CLEVELAND 4, OHIO

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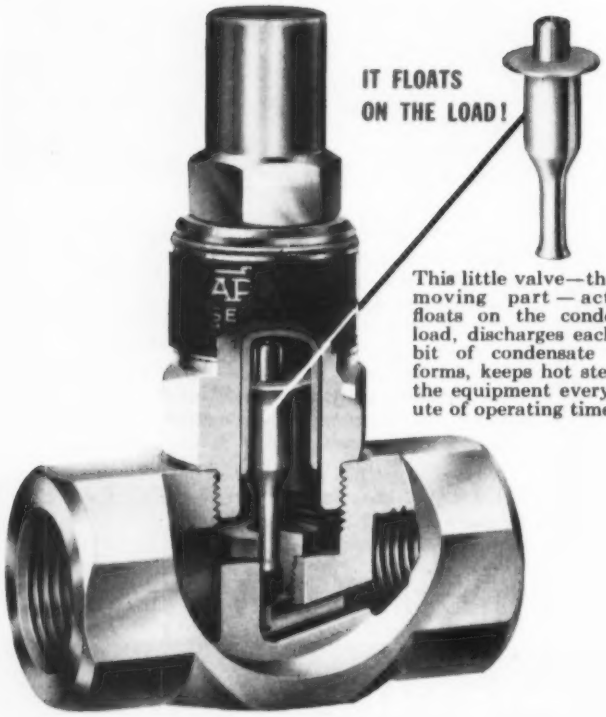
3000 impulses help keep mid-west refinery "on stream"



This little valve—the only moving part—actually floats on the condensate load, discharges each tiny bit of condensate as it forms, keeps hot steam in the equipment every minute of operating time.

THIS big refinery at Lawrenceville, Ill.—like a lot of other important refineries — uses Yarway Impulse Steam Traps.

Over 3000 Yarway Impulse Traps are installed on tracer lines and for draining steam headers.

Popular features of the Yarway Impulse Steam Trap are its ability to get equipment *hot in a hurry*—and keep it hot! . . . also its small, handy size—fits in easily in any location; its stainless steel body and working parts; quick installation; easy maintenance; low initial cost.

Another advantage—IMMEDIATE DELIVERY from 250 local distributors, plus quick service from nearby Yarway field engineers.

More than 900,000 Yarway Impulse Steam Traps have been sold. For a free Steam Trap Selector, write . . .

YARNALL-WARING COMPANY
145 Mermaid Ave., Philadelphia 18, Pa.

YARWAY® impulse® steam trap

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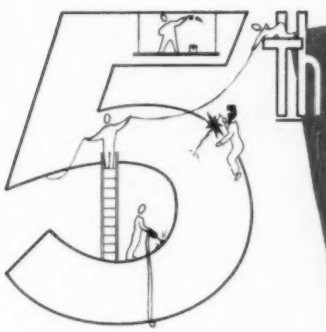


5th Plant Maintenance and Engineering Conference Program

The Program:

BETWEEN MONDAY morning, January 25, and Wednesday night, January 27, several thousand plant engineers, maintenance engineers and others interested in plant engineering problems will assemble at the Conrad Hilton Hotel on Chicago's Michigan Blvd. to attend the sessions of the 5th Plant Maintenance and Engineering Conference.

This year, the program's scope has been enlarged slightly to encompass more of the plant engineer's problems; in addition to the maintenance aspects of his job there will be discussed such problems as sanitation, work measurement, incentives, selection of lighting equipment, and corrosion control. Unfortunately, plant construction problems—planning, layout, modernization, work scheduling, coordination, materials—have yet to be added to the agenda. On the other hand, this year's program should add many plant engineers to the list of those who consider the Conference a "must" item.

For the first time the Show, which is held annually in conjunction with the Conference, will not be under the same roof; it will be held at the International Amphitheater, 42 St. and S. Halsted on the eastern perimeter of the stockyards. Whether or not this will adversely effect the attendance at the Show is problematical. Certainly, the slight additional effort required in the added transportation should be well repaid.

Monday, January 25—10:00 a.m.-12:30 p.m.—General Session.

Opening Remarks by the General Chairman

Planning and Scheduling Maintenance Work

(a) *Summation of Principles*

Responsibilities of the planning and scheduling department. Setup of an effective organization. Origin of requests. Kinds of work done without requests. Work schedules. Work orders. Man and machine loads. Paper work for authorizations, orders, stock records, machine records. Instructions and standard operating practices—how they should be given (written form, manuals). Work measurement—should planning and scheduling department have responsibility or does it belong to industrial engineering department? What should work measurement include (time-study, methods-time-measurement data, estimating, incentives)? Planning for routine maintenance. Planning for emergency maintenance. Relationship of planning and scheduling to budgeting and costing. Planning for a minimum of non-productive maintenance time.

(b) *Case Example I.*

Description of an actual effective planning and scheduling system. Speaker to tell just what the planning and scheduling department does; also to compare results obtained under the system and results before system was installed. This case to be taken from a middle-size plant with between 1,000 and 2,500 shop employees.

(c) *Case Example II.*

Same as (b)—except to be taken from a small plant with under 500 employees.

* * * *

Monday, January 25—8:00-10:00 p.m.—Concurrent Sectional Meetings. (The three meetings indicated by single asterisks will be repeated Tuesday evening. The meeting indicated by two asterisks** will be continued Tuesday evening.)*

Preventive Maintenance—Pros and Cons*

What preventive maintenance is. Economic justification of repair maintenance vs. preventive maintenance. Under what conditions is preventive maintenance more costly than break-down maintenance? What are the relationships of preventive and breakdown maintenance to obsolescence? How is a preventive maintenance program set up? Who makes the inspections? Who does the repair work? What kinds of repairs should be made as a part of inspection routine? What records should be kept and how should they be used? To what extent can responsibility for prevention be left in the hands of foremen and/or craft-heads? Should a manual of instructions be provided? Should meetings of division and craft-heads be held to review performance and procedure? What steps can be taken to make sure that unnecessary work is not being done in the name of preventive maintenance? Who should have the special responsibility for keeping up a constant review of the inspection frequencies, repair procedures, and paper work to prevent acquisition or retention of unnecessary work?

Training People for Maintenance Work*

Who should select the people to be trained? Where do the applicants come from? How old are they? What must be their characteristics, experience, and education? *Apprentice training:* How long? What should be taught? Classroom hours? Homework? Pay? Advancement? *Supervisor training:* Should it be limited to training supervisors to train people? Or should there be educational courses, both practical and cultural, for the supervisor? What types of meetings? What subjects? What kinds of teachers? Where to get them? *On the job training:* Can it be coordinated with apprentice and supervisor training? Methods of checking up on effectiveness of on-the-job training. *Craft training:* What are the practical limits? *Material and visual aids for courses:* Where does it come from? Are there available recommendations worked out by educational institutions? Can the discussion leader outline a specific course covering all or almost all of the preceding items?

Organizing People, Policies, and Procedures for Effective Maintenance*

Management-maintenance, design-maintenance, and production-maintenance relationships. What is the industrial engineer's place in maintenance? Should a plant engineering department be part of a maintenance setup or be independent of it? How coordinate the planning and operating functions of the different departments mentioned? Is it better to have the supervisory organization made up of men who handle all phases of maintenance work or craft foremen, each of whom handles his own specialty? What proportion of maintenance work, if any, should be done by people on the production payroll under production department supervision? What are the functions of production department staff engineers with regard to maintenance work and project control? Under what conditions should maintenance work be contracted to outside concerns? Under what conditions should the organization include staff as well as line personnel? How many men should a supervisor direct? Should crews be on craft basis with individual foreman, or on mixed basis with general foreman? What should be the ratio of clerks to craftsmen? What are the guideposts in determining whether maintenance should be preventive or breakdown? What factors should dictate amount of work done by outside contractors? To what extent should maintenance advise as to the selection of production equipment? What guideposts should indicate number of maintenance shifts?

"Best quarterback in the country three years ago!"

Sanitation—Methods, Materials, and Control**

What are proper standards of sanitation? How do they vary with the industries? To what extent should standards be influenced by considerations of employee health and morale? To what extent should they be influenced by product purity? What are the principal methods of maintaining accepted standards? Where do the responsibilities lie? Who should have the authority? What of the cost of sanitation? Whose is the responsibility for sanitation inspections? Is there value in giving educational courses in sanitation? What is the relationship of housekeeping to sanitation?

Maintenance by Area Compared with Centralized Maintenance

Comparison of the two kinds. Under what conditions is each preferable? Give drawbacks as well as advantages. Origin of work orders under each. Requirements for supervisory personnel. Requirements for working force. Lines of authority and responsibility. Relationship of preventive maintenance to both systems. Recommended practices in checking on work done. Keeping track of costs. In decentralized maintenance, how can construction work be handled?

Work Measurement, Work Standards, and Incentives

Measuring work and setting up standards. Cooperation with the industrial engineering department in setting the stage for the establishment of a work measurement program involving equipment records, planning and scheduling, standardization of crews, and providing handling methods for maintenance work. Work measurement techniques—time study, ratio delays, MTM data, estimating incentives. What standard times are; how they can be obtained, and how used. Show how job evaluation is applied to maintenance work. Kinds of incentives ordinarily used, and kinds of maintenance work for which they are appropriate. Economic limits to application of incentives. Do's and don't's in adopting incentives, and operating under them. Where does work simplification fit in? To what extent should published standards be used, i.e., in the form of standard instruction sheets or maintenance handbooks? Be certain to bring out the difficulties and disadvantages as well as advantages.

Getting Management's Okay on the Maintenance Program

Knowing what management wants (controlled costs, reduced production losses, improved safety records, improved employee relations, continuous operation, advance planning). Knowing what can be offered to management and presenting it clearly and briefly. Tips on getting management's approval for items such as preventive maintenance, work measurement, application of incentives, use of records and reports. Differentiating between maintenance and other departments; what to detail and what to generalize; showing costs and benefits.

Problems Met in Handling Maintenance Labor

Differences in behavior by craft unions and industry or plant unions. Union regulations of many kinds. Labor's attitudes toward incentives; toward apprentices and training; toward using helpers' mechanics. Difficulties presented by jurisdictional disputes. Promotions—within a classification; from mechanic to supervisory status.

"Better use the left hand bucket once in a while!"

Attitudes toward and adjustments for shifts. Insubordination. Absenteeism. Overtime and its allocation. Seniority and its effect, if any, on work assignments and promotions. Coordinating the work done by outside contractors with that done by the plant maintenance forces.

* * * *

Tuesday, January 26—9:00-11:30 a.m. —Concurrent Round Table Discussions. (To be repeated Wednesday afternoon.)

Inspection and Upkeep of Electrical Distribution Systems

Dealing with substations, feeders, transformers, breakers, switchgear, fuses, relays, voltage regulators, cables, wiring, protective devices, instruments, power conversion apparatus.

Maintenance of Electronic Control Equipment

Inspection and upkeep of electronic devices for the measurement and control of physical quantities; processing and process control; and detection, inspection, protection, and supervision of process, personnel, or property.

Handling Equipment and Methods of Handling Used in Maintenance Work

Use of electric and/or gasoline trucks to rapidly transport men, tools, materials, and supplies to maintenance jobs. What tools and supplies are carried on trucks: (a) for electrical work; (b) for work on buildings; (c) for work on mechanical equipment? Use of elevating trucks for overhead work. Moving equipment in layout and re-layout work. Methods of handling in doing dismantling and remodeling work. Handling equipment used in maintenance shops (machine, electrical, carpenter, tinsmith, other). Discuss gasoline vs. electric trucks as to initial investment and upkeep.

Maintenance of Materials Handling Equipment

Cranes (overhead, monorail, and other): Inspection frequencies and routine preventive maintenance of cabs, rails, wheels, hooks, chains, controls. Similar for hoists. Similar for gasoline and electric mobile trucks. Similar for all kinds of conveying equipment. Give samples of inspection forms. Discuss maintenance of conveyor belts, pulleys, and rollers.

Lighting Equipment—Its Selection and Upkeep

Illumination—terms, calculations, intensities recommended for specific kinds of work. Light meters. Characteristics of lamps. Combinations of mercury, arc, incandescent, fluorescent, cold cathode. Installation. Mounting. Local lighting. General lighting. Replacement policies. Cleaning methods.

Lubrication—Methods, Systems, Lubricants

Who should have the responsibility for selection of lubricants? Who should have the responsibility for application? How should the supplies be stored? How should they be issued? How should applicators be stored, maintained, and issued? Setting up the calendar for lubricant application. Keeping records. Analyzing failures due to faulty lubrication. Use of lubricants other than oil and grease (graphite, water, other). Cost of wasted lubricants. Oil reclamation. Making the lubrication job safe.

Maintenance in Plants Having up to 25 Maintenance Employees

Placing the responsibility for maintenance. What should be the line of au-

thority and how many individuals should there be on the supervisory staff? How many clerks? Must the principal crafts be represented by workers? By supervisors? Should a schedule of inspections be set up? How much paper work is justified? What records must be kept? How much of the maintenance work should be preventive and how much breakdown? Under what conditions should work be performed by outside contractors?

Maintenance Stores and Storekeeping

Where does the storeroom personnel fit into the organization? Positioning storerooms in the plant. Can some items be kept in general stores? How does the workman obtain the material from stores? How are stocks and stock records kept up? Who determines what items are to be stocked? How often is physical inventory made? How are surplus or obsolete stocks disposed of? Can general instructions be given for physical layout?

Maintenance of Mechanical Service Equipment

Dealing with those kinds of equipment common to all manufacture, such as mechanical transmission, compressors, air conditioners, humidifiers, fans, ductwork, dust control equipment, heating and ventilating equipment, plant furniture. Under preventive maintenance policy, what should be the extent and frequencies of inspections? What records should be kept? How should they be used? Under breakdown maintenance policy, what should be the extent and frequencies of inspections? What records should be kept? How should they be used?

Maintenance of Plant Buildings

When is a building in good condition? What kinds of repairs are necessary to keep buildings in good condition? What inspections should be made, at what frequencies? What kinds of roofs give longest life and minimum trouble? How overcome floor troubles—concrete, plastic, wood? How often repaint, and how do it at least cost and with least interruption to production? What statistical data on life of building materials are

available? Ditto costs of materials and maintenance, including labor? What inspection and upkeep procedures should be followed as to fire protection systems? Are there some worthwhile do's and don't's about the upkeep of parking lots, driveways, grounds, streets?

Maintenance of Power Plant Equipment

Should schedules be established for inspection of all equipment in the power house? If so, what should the frequencies be for the most important items? Should preventive or breakdown policy be followed? What should be the policy on standby equipment? What records of equipment and performance should be kept? What should be the relationship of the power plant maintenance crew to the general plant maintenance crews? What are the principal troubles with fuel-preparing and burning equipment, boilers, generators, turbines, compressors, pumps, coolers, ash-handling systems, refrigerating equipment? What are the remedies? For what purposes are plastic and alloy pipes particularly suited? Discuss mechanical seals and packings.

Janitor Work—Methods, Techniques, Organization, Control

Where does janitor work fit into the maintenance program? Who is responsible for it, and to whom is he responsible? What is the difference between janitor work and housekeeping? Is janitoring best set up on the area or centralized basis? What should it cost per square foot of floor space, or per employee? Discuss standardization of services, procedures, equipment, and supplies. How extensively can janitorial work be mechanized?

Maintenance in Chemical Plants

Scheduling of the maintenance work and organization of the scheduling department. Determination of priorities. Location of stockrooms. Kinds of stores to be carried. Salvage (of steel, pipe fittings, valves, and the like). Instructing maintenance people in the nature of the processes from the point of view of protecting people and plant. Equipment classification,

(Continued on page 138)

Plant Engineering Societies Luncheon Planned

UNDER THE sponsorship of the Plant Engineers' Society of Chicago, a luncheon will be held at 12:30 pm, Wednesday, Jan. 27, for members of all Plant Engineering Societies; men who are interested in having a society in their home cities are invited to attend and get acquainted with their counterparts in groups which are now active.

This luncheon, which will be Dutch at around $3.00 per plate, is to be held in the world-famous Saddle and Sirloin Club of the Stockyards Inn which adjoins the International Amphitheater. Purpose and idea behind the luncheon is largely social although some members of the various societies have expressed an interest in discussing the formation of a national group of plant engineering societies.

In order to determine, with some degree of accuracy, the number of places which the management of the Saddle and Sirloin must set for luncheon, it will be necessary for the Chicago Society to be informed by those planning to attend. The coupon on this page is provided for this purpose. It should be filled in and mailed to Ted Ramond, Secretary-Treasurer of the Plant Engineers' Society of Chicago. Mr. Ramond's address is: Plant Engineer, Goodman Mfg. Co., 4834 S. Halsted St., Chicago, Ill.

If you are an independent (not a member of any Plant Engineering Society) Mr. Ramond would welcome a letter from you.

Place. Saddle and Sirloin Club, Stockyards Inn, International Amphitheater, Chicago, Ill.

Time: 12:30 pm, Wednesday, January 27, last day of the Plant Maintenance and Engineering Show

Mr. Ted Ramond, Plant Engineer
Goodman Mfg. Co.
4834 S. Halsted St.
Chicago, Ill.

I plan to attend the Plant Engineers' Societies' Wednesday Noon luncheon on January 27 at Stockyards Inn's Saddle and Sirloin Club. Please reserve a seat for me.

☐ I am a member of the _____ Plant Engineers' Society.

☐ I am not a member of any present plant engineering society but I would like to see one organized in my own city of _____.

_____
Name

_____
Title

_____
Company

_____
Company Address

What's Doing Now With PLASTIC PIPING?

Where conditions suit, plastic pipe is being used for water service, crude oil and wines . . . A test installation for underground conduit lines has also been installed . . . Advantages claimed for the piping are flexibility, lightness, ease of installation

WHERE CONDITIONS of pressure and temperature are suitable plastic pipe—for example, of the cellulose acetate butyrate type—has been receiving attention in widely divergent areas of industrial usage. One of the most recent installations has been made in a 9 mile pipeline delivering crude oil from a producing field in the Williston Oil Basin to a shipping point on the Great Northern Railway.

Pipe used in this particular installation is 3 in. inside diameter, with a wall thickness of 0.125 in., and was produced of Tenite butyrate plastic by extrusion. Designed to operate a maximum pressure of 90 psi, at a temperature of 60 F, the line is designed to deliver 2,500 bbl of crude oil per day.

Other examples include an installation in a winery. Here the piping has been in use for the past 8 years and it is reported that the 2000 ft of piping was shown, by a recent check, to be completely free of corrosion. Temperatures of the wines have varied from 18 to 112 F.

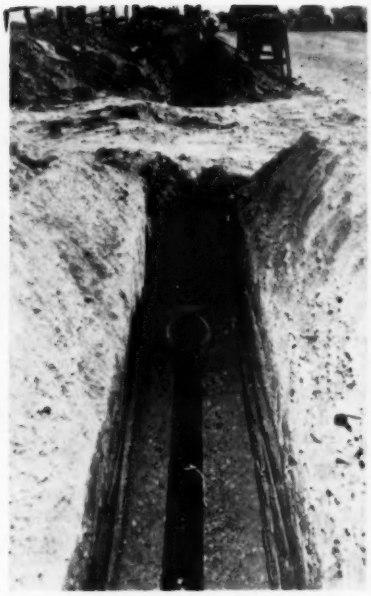
Water mains of plastic are also undergoing scrutiny. An installation of 5000 ft of 4 in. pipe has been installed in Haubstadt, Indiana, in an extension of water mains to a subdivision. For the first time, too, a public utility is testing the pipe as an electric conduit in Kingsport, Tenn. Here the test project consists of a full city block installation.

It was necessary to dig a curved ditch section when installing this water pipe extension in an Indiana city. Semi-rigidity of the plastic piping permitted it to conform to make turns to the curve of the ditch without use of angle joints

After the piping has been assembled by means of slip-sleeve solvent-welded couplings it is lowered into the ditch by one man. Part of the first cross-country pipeline entirely of plastic, it delivers crude oil distance of more than 9 miles

All photos: Eastman Chemical Products, Inc.

Ralph Baker, technician in Tennessee Eastman Company's applications laboratories, is holding the ends of two 90-deg bends at a spot in the Kingsport Utilities conduit where a lighting pole will later be installed. The test installation has been made by the utility in full city block in Kingsport, Tenn.



In preparation for running this butyrate plastic pipe across a driveway, the ditch is dug, then ceramic tile put in place and the ditch is covered with dirt at that point. When the plastic pipe reaches this point it may be run immediately through the ceramic pipe. This cuts time the drive is impassable

In this 8-yr old installation of 2-in. pipe at the winery of G. F. Heublein & Bro., Inc., the wine flows from large storage vat at left (outside photo) through clear butyrate line to tax payment tank and bottling room. Aging qualities of the pipe have been reported as good with no indication of discoloration

Methods for Connecting Plastic Pipe

Solvent and cement join pipe in a permanent bond

Metal straps hold saddle type fitting for service line

Slip-sleeve couplings join this pneumatic cup conveyor

Special adaptor made for joining plastic pipe to steel

Ventilating Gas-Air Mixtures

When installing exhaust hoods or other ventilating openings for handling mixtures of gas and air better consider the specific gravity of the gas and its diffusion rate. They will influence your final decision

By **JOHN D. CONSTANCE**, Consulting Engineer

CONSIDERABLE misunderstanding appears to exist as to the importance of vapor density in the design of ventilation systems. Frequently, exhaust hoods or other openings are located at the floor for escaping vapors "heavier than air" and at the ceiling for vapors "lighter than air." In most applications such an approach is of little value. Hazardous gases and vapors are airborne and follow air currents set up by many forces and are not subject to purely appreciable motion either upward or downward because of their own density.

Under normal conditions of occupancy and operation an escaping vapor is well mixed with room air and the resulting density of the mixture approaches closely that of air. For example, with gasoline vapor and air, the following simple calculation may be used to determine the resulting mixture density, assuming that the lower explosive limit of vapor in air is 1.0 per cent, the maximum allowable concentration of gasoline vapor in air from the health standpoint is 500 ppm, and a reasonable molecular weight for gasoline is 120.

Specific gravity of air is 1.0

Specific gravity of pure vapor is (molecular wt gasoline/molecular wt air) = (120/29) = 4.14.

One per cent is equivalent to 10,000 ppm or 1 part vapor to 99 parts air. Then,

$$(0.01)\ (4.14) = 0.0414$$
$$(0.99)\ (1.00) = 0.9900$$
$$1.0314.$$

This is the effective specific gravity of the mixture. It may also be found that for the 500 ppm condition, the resulting sp gr would be 1.0016.

The vapor-air mixture compared to air alone would have a small tendency to move downward expressed by the ratio of 103.14 to 100 and not by the ratio of 4.14 to 1 as is frequently implied.

Experience has shown that solvent vapors and gases do not usually collect near the floor in markedly higher concentrations than at the breathing line, so long as the "mixing" forces are present in any one or several of the well-known forms. Air motion is created in the neighborhood of vapor-generating processes by many forces not subject to direct evaluation. Motion or energy fundamental to the machine or process itself causes dispersion of the gas or vapor. The fan action of rotating wheels and pulsating displacement of air by reciprocating tools all play a part in preventing stratification. Forces incidental to the operation of the machine such as the air blast from totally-enclosed fan-cooled electric motors, vibration of machinery, natural convection currents and motion of traffic all help in this regard.

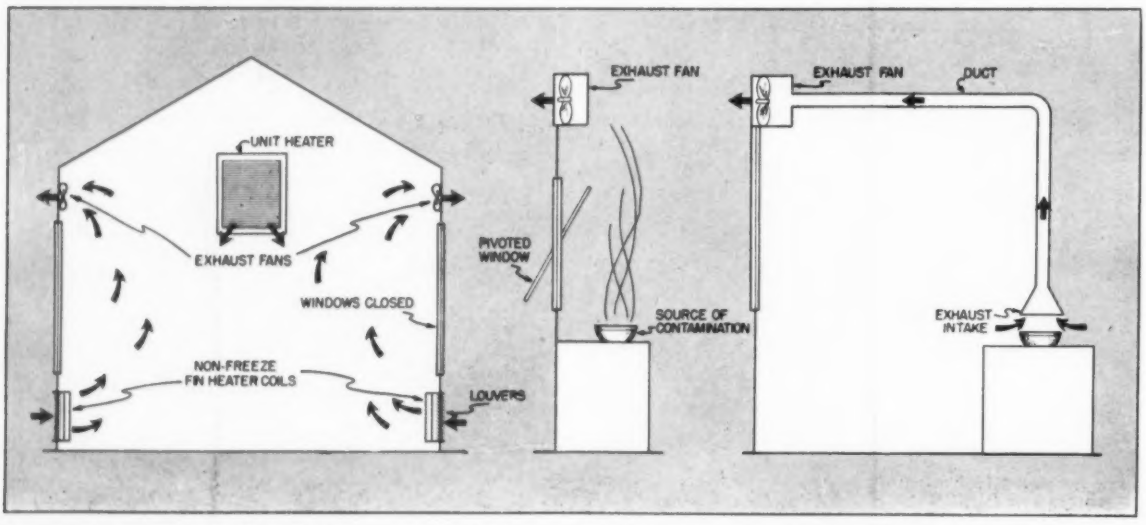
Table compares the specific gravities and diffusion rates of various vapors

GAS OR VAPOR	SP GR*	DIFFUSION RATE*
Acetone	2.0	0.69
Acetylene	0.90	1.05
Ethyl Alcohol	1.60	0.79
Ammonia	0.59	1.30
Benzene	3.00	0.58
Butane	2.00	0.71
Carbon Disulfide	2.60	0.62
Carbon Dioxide	1.50	0.82
Carbon Monoxide	0.97	1.02
Ethyl Ether	2.60	0.62
Ethylene	0.97	1.02
Gasoline	4.14	0.53
Hydrogen	0.069	3.81
Hydrogen Sulfide	1.17	0.92
Illuminating Gas	0.65	1.24
Kerosene	4.50	0.47
Methane	0.55	1.35

*Air equals 1

Gas escaping from a pipe or tank and vapor given off by a liquid such as gasoline, tend to diffuse in the air in about the same way that a drop of ink in a glass of water diffuses through the water. Some gases

(Continued on page 146)



Drawing shows suggested ventilation arrangement for plant building. Separate units can be connected to fan discharge

Plant Goes to Rafters — Escapes Monkey Wrenches in Its Plans

Quite a few industrial plants have gone to rafter storage for in-process storage . . . Here's how one of them performed the task, cleared its floor of space-wasting clutter and also speeded production

EXPANDED PRODUCTION can throw gorilla-sized monkey wrenches into the best laid plans. Consider John Bean Division, Food Machinery and Chemical Corp. When PLANT ENGINEERING last visited the San Jose, Calif. plant (see PLANT ENGINEERING, May, 1951), its 180,000 sq ft (300 by 600 ft) seemed adequate. Most important, materials handling was geared to cross-aisle fork-lift operation.

Then John Bean Division began to hit its production stride, branched from agricultural machinery and fire trucks into parts for military tanks, currently being manufactured by its close-at-hand sister plant. And suddenly those aisles, especially to and from the paint booths, just weren't adequate.

John Bean's solution: they took to the rafters.

"There wasn't any place else to go—but overhead," admits H. Taylor, Methods and Standards Engineer.

Recently installed is a 270 ft trolley with clevis attachments. The trolley is both conveyor to and from the paint booths and efficient, out-of-the-way storage. Its length (an additional 60 ft is currently being added) and speed (from 4 to 12 fpm) is geared to the paint drying cycle. Up to 150 parts weighing a total 1800 lb, can be simultaneously conveyor-boosted above-floor. The conveyor loops back upon itself, thus requires a relatively few feet of overhead space. It's a closed loop, "storing" painted parts as they move through the drying cycle, returning them without additional handling to the paint booth for a second and third coat.

Best of all, in this combination drying-storage cycle, two men (one on the business-end of a paint spray gun, the other loading-unloading the conveyor) can operate the line. For the unloading and loading stations are adjacent.

The overhead trolley can handle an estimated 15000 small or 2500 large parts a day (8-hour shift). This load is possible through use of John Bean-invented "Lazy Susans" —actually a hanger-fixture which can be loaded with up to 10-12 parts. Thus, although hooks are spaced every 18 in. along the trolley belt, more than the approximate 150 parts can be handled simultaneously through any one drying cycle (that is, the time required for the slow-moving trolley to complete the 270-ft roundtrip).

And all this handling-storage takes place overhead, utilizing space which had been wasted. In effect, John Bean acquires two-level production: (1) production occurring on its regular factory floor slab; (2) handling and storage in the area between roof beams and floor slab.

In operation, the Webb No. 348 trolley chain, hung every 18 in. with hooks, exits the paint spray booth, circles it at shoulder level, runs through a fast-dry oven (used only occasionally on special slower-drying paints), and begins a steep, 30-deg climb to the plant's below-roof area. Within about 30 to 40 ft, the trolley with its newly-painted parts has climbed to an above floor elevation of 18 ft 6 in. It then makes a sharp, 24 in. radius turn, runs another 30 to 40 ft, then doubles back

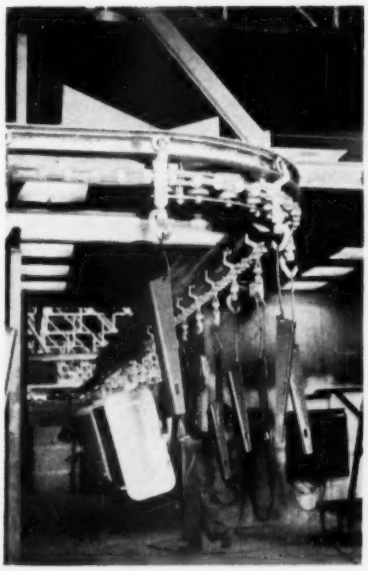


Fig. 1. Here's the exit end of the paint spray booth. Soon the conveyor takes off rafterward as shown in sketch

Fig. 2. Protective screen beneath the moving parts makes for safety on floor

on itself through two more 24-in. radius turns. Now, from the 18 ft 6 in. elevation, the trolley and its load begins to drop floorward. Within another 40 ft it has reached the 7 ft elevation. Here are the adjacent stations—one for unloading finished parts; another for loading unpainted parts. Another 24 in. turn and the line enters the spray booth.

"Quantity defeated our best laid plans," says Taylor. "And as important as sheer quantity was variety of parts handled."

He goes on to explain how John Bean's paint-booth handling had been set-up on a frame-caster system. That is, various parts were segregated by shape and weight, hung from hooks on a frame, rolled into the paint booth and processed.

Pretty soon, however, segregation forced use of 6 to 10 different racks simultaneously. These crowded the paint booth, made handling unwieldy. The racks not only took up booth area, but also had to be stored outside the booth—in two areas. One was devoted to finished parts, another to those ready for painting. And this storage area congested the paint booth section, consumed space which could be more advantageously used for other processes. Thus arose the need for the overhead, rafter-storage system.

Wherever the trolley travels above a working area it's underhung with a 5 ft wide, expanded metal guard. This open-latticed guard is framed by 1 by 1 in. angles, supported by 1½ by 1½ in. angles, and allows about 4½ ft clearance between the conveyor hooks and the guard.

It might be thought that open-lattice would allow paint drippings. However, this is not the case. For the speed of the conveyor (usually 8 ft per minute) is so geared that whatever drippings do occur, take place before parts are elevated overhead. Drippings, if any (and this depends upon the skill of the painter), occur in the paint booth.

Near at hand is another space-saving set-up: John Bean's Bonderizing department. Whereas many a plant gives over a thousand or more square feet to so sizable an installation, only about 600 sq feet at John Bean Division are required for five dip tanks. Reason: they're off-set, actually overlapping, and set deep into the floor. Overhead, a floor-actuated 2-ton capacity hoist runs on a circular monorail, lifting parts into one tank, then another.

Big reason for having Bonderizing so near the paint booth is to paint-process Bonderized parts just as soon as possible. This need necessitated assigning floor space to the process—and out of the need came John Bean's own Bonderizing tank design.

What's so unusual about the Bonderizing, off-set tanks? They're vertical (thus space-saving), rather than horizontally placed. A typical tank is 10 ft deep (sunk into the floor) and 6 by 6 ft. All five are set in an overflow, pump-emptied sump, with only 36 in. of each tank above floor as a safety measure.

Three tanks are grouped as a unit, consuming only 18 lineal feet. Off-set against these are two other tanks. Because of the circular, overhead hoist design, these two are off-set 3 ft on each tank. This means that the total lineal footage of all five is but 24 ft. Tanks are of stainless or mild steel, and are exteriorly insulated with 2 in. of Fiberglas, covered with 20-gage material. This 20-gage cover was stiffened with a kind of semi-embossed design.

Compact Bonderizing, coupled with overhead drying-storage, combine at John Bean Division to solve a problem of space.

Says Methods and Standards Engineer Taylor, "When you've used all your floor space, there's still a bonus 'floor'—that unused, below rafter area. It's a kind of additional, layered production floor. And if you use it efficiently, a plant with 1000-sq ft of physical floor area can discover that actually it has another 1000-sq ft or 2000 all told. And in this day of increasing plant costs, that's a bonus worth developing."

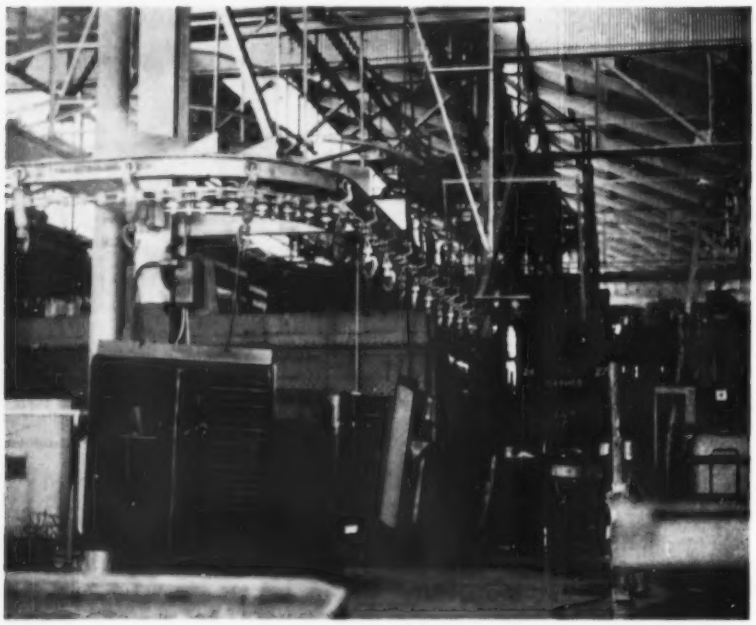


Fig. 3. Here is where the conveyor starts its upward climb. This is in-plant storage inasmuch as the conveyor holds nearly one-day's parts in abeyance

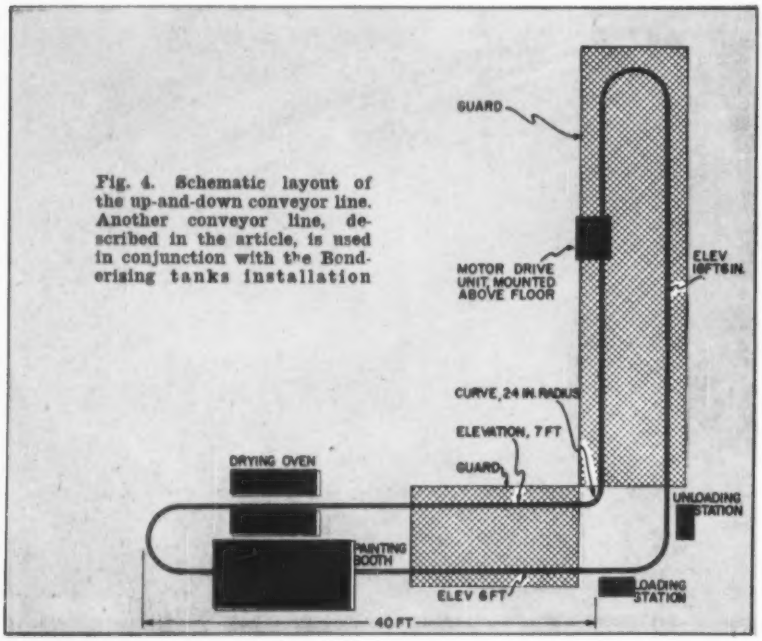


Fig. 4. Schematic layout of the up-and-down conveyor line. Another conveyor line, described in the article, is used in conjunction with the Bonderising tanks installation

Fig. 1. The appearance of the main office of this plant has been improved by the installation of Zourite facing material on the upper portion of the structure

New Faces For Old Plants

This facing material is turning old plant fronts into new faces in but a few hours

MANY OLD plant fronts are being turned into working examples of modern architecture with the help of a facing material that can be installed in a few hours. The facing material that performs this metal magic is Zourite. It is a pliable metal that can be curved vertically to a two-foot radius, or it can be used as an expansible facing that can be adapted to the building conditions without cutting and fitting.

According to the manufacturer, any surface which needs a decorative facing material can use Zourite. It can be applied to steel, wood or brick. Such applications as pylons, partitions, soffits, sign backings, horizontal spandrels, and as trim for bulkheads, pilasters and columns are possible.

This facing material consists of porcelain enamel fused at 1000 F to 0.050 alumilited aluminum. Rolled with a corrugated profile, this material has inherently strong, clean lines. It is easily cut and handled on the job or can be shop fabricated. It comes in 16 and 20 ft lengths and in widths from 2-⅛ in. to 8-½ in.

Installation consists of framing the surface to be covered with trim members at every corner. Where the facing material is to be applied vertically, strips of stainless steel furring channels are screwed, nailed or riveted horizontally to the surface. Once the area is framed and the furring channel applied, the hard part of the job is done.

By simply using clips which are inserted into the furring channels, strips of Zourite are applied to the surface. These clips resemble a half-clenched, three-fingered hand. The two outside fingers are pushed down to secure the strip at each junction with the furring channel. Pieces of steel blocking under the facing prevent buckling.

The finish of this facing material is easy to maintain. The manufacturer recommends a wash with soap and water about every six months to preserve the surface or a waxing once a year will do the trick.

A companion piece, the K-Louver, controls the rays of the sun entering the plant. The K-Louvers are specially-designed curves, in lengths of 16 and 20 ft, which permit maximum penetration of soft diffused daylight yet exclude intense solar glare and heat.

Viewed from the interior, an evenly illuminated area with no distracting striations is achieved by the K-Louver shape. In a horizontal application, the manufacturer states that it will provide glare reduction, heat deflection and sound control. In a vertical application, it offers such advantages as direct sun exclusion, good ventilation and visibility.

For More Information

If you would like additional information about Zourite or K-Louvers, either write The Editor, Plant Engineering, 110 South Dearborn St., Chicago 3, Illinois, or indicate your interest on the bottom of the postage-paid cards elsewhere in this issue.

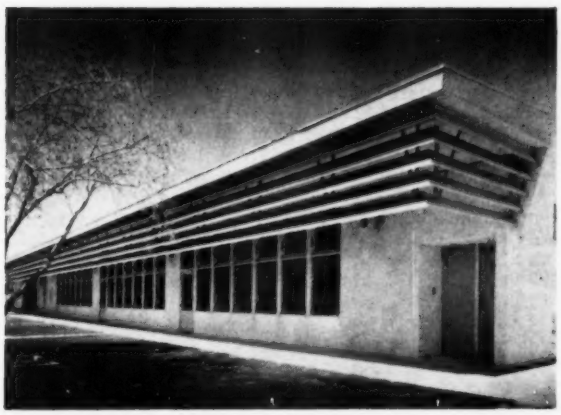


Fig. 2. This illustration shows horizontal application of K-Louvers, which provide glare reduction, heat deflection

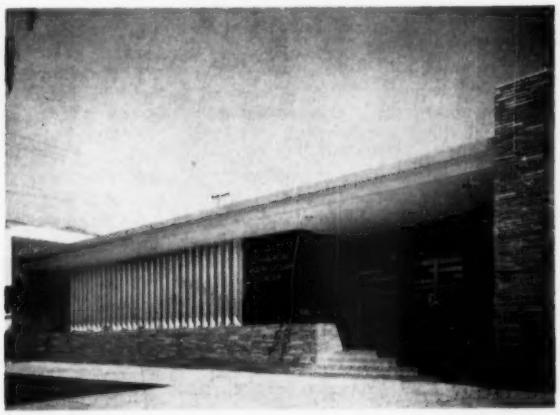


Fig. 3. When installed in a vertical position, louvers exclude direct rays of sun, permit good ventilation and visibility

Nomograph Helps Determine Economical Ordering Quantity

For engineers who have no purchasing department to help them, this nomograph, or one like it, may speed calculations on repetitive purchases

By MARTIN H. SALTZ, Industrial Analyst

AS AN IMPORTANT part of their functions, many engineers are faced with the problem of developing the most economical purchase quantity or standard ordering quantity in which to buy an item. Since this problem is a recurring one, there are several methods which are attempts at mechanizing this procedure by using mathematical equations.

This article discusses one of the equations, and more particularly, a technique for simplifying the handling of such an equation. In general all of the formulas for determining the standard ordering quantity include certain factors which are agreed upon as being relevant to the problem, such as: a) Consumption per year; b) Interest charges per year; c) Storage charges per year; d) Purchase price per item; e) Total cost of preparing the purchase order; f) Deterioration charges per year; g) Obsolescence charges per year; etc.

In certain industries some of the above mentioned factors might not be pertinent, and therefore would be omitted while others which are of importance would be introduced. Also, from industry to industry, and within firms of a particular industry, the relationship between the factors considered in determining the economical purchase quantity will vary.

This is confirmed by the assortment of equations presented in textbooks and handbooks on this subject.[1] Therefore, it is felt that each concern must develop its own equations or select an appropriate equation for computing the economical purchase quantity.

In general, all of the equations agree on the basic relationships between certain of the factors. Usually, the quantity to be ordered varies as the square root of the consumption and inversely as the square root of obtaining and carrying the order. As soon as the relationships between the factors get this complex, they don't lend themselves to ready manipulation. In the case of a large West Coast electronics firm, the equation developed by Davis and presented in the Production Handbook by Alford was found to be directly applicable. Specifically, the equation is set up as follows:

$$Q = \left(\frac{2GS}{CI + 2BE}\right)^{\frac{1}{2}}$$

WHERE:

- Q = Standard ordering quantity in number of units
- G = Total cost of preparing the purchase order, in dollars
- C = Total purchase price of one unit of material including freight charges in dollars
- I = Interest rate on money per year in per cent and used as a decimal
- S = Rate of consumption of material in units per year
- B = Net storage floor area occupied by one unit of the material in square feet
- E = Annual storage charges per square foot of storage floor area, in dollars

Such an equation is certainly unwieldy and does not readily lend itself to solution by unskilled clerks and other office personnel. It was evident that an easier method of solution was required.

In order to accomplish this, a nomograph was designed which is illustrated on facing page. As an example of the use of the nomograph let us assume the following:

1. Annual storage charges per square foot of storage area is $6.

2. Net storage floor area occupied by one unit of the item is 2 square feet.

3. Total purchase price of one unit including freight charges is $10.

4. The interest has been standardized at 5 per cent.

5. The rate of consumption of the item is 4000 units per year.

6. The total cost of preparing the purchase order is $15.

The solution using the nomograph is as follows:

1. Using a ruler, line up the value for B (2) with the value for E (6), noting where the line intersects the horizontal axis of the quadrule section.

2. From the intersect draw a vertical line to the appropriate C line ($10).

3. Draw a horizontal line to the edge of the quadrule section.

4. With a straight edge, line up the value for S (4000) with the value for G ($15) and note the intersect on the U axis.

5. With a ruler, line up the intersect on the U axis with the intersect found in Step 3 and read the answer on scale Q.

In this case 78 units would be the standard ordering quantity. These steps are illustrated in the key on the nomograph.

Although the explanation of the use of the nomograph for solving the equation seems to be quite involved, the actual application is relatively simple and can certainly be mastered in less time than it would take to solve the equation by other means.

Using this technique to solve the equation has enabled the manufacturer for which the nomograph was designed to delegate this duty to employees who otherwise would take much longer to compute the standard ordering quantity per item.

In using a nomograph there are several things which we must be aware of.

1. The nomograph is designed to solve a particular equation. (In this case the Davis equation for Most Economic Purchase Lot.)

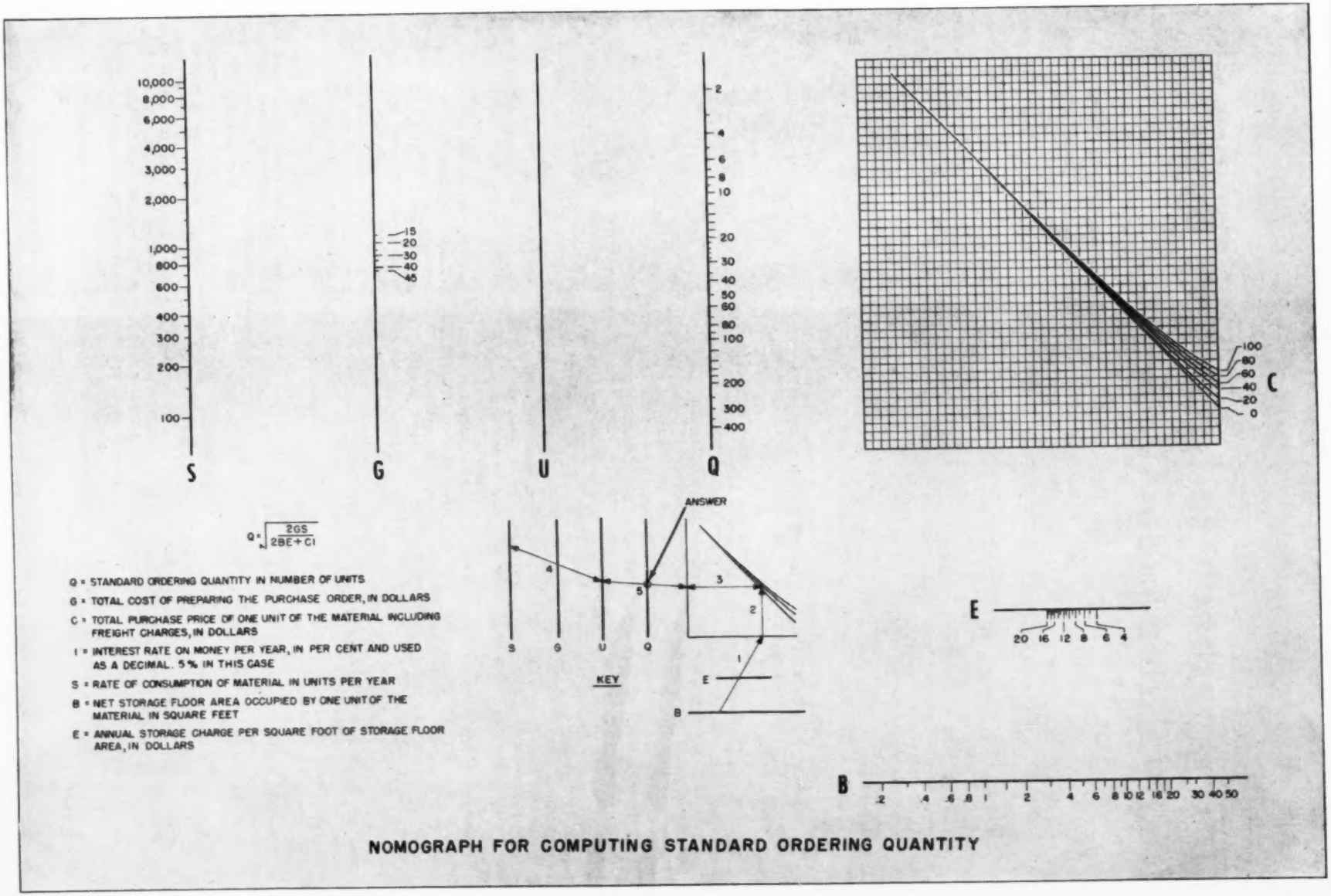
2. For each of the factors a certain anticipated range was arrived at. This range for each variable will vary from concern to concern. Referring to the nomograph again we can see that B was expected to range from .2 to 50. E was expected to range from 4 to 20, etc.

3. The nomograph shown is a custom-made device and is only applicable to the equation for which it was made.

4. Having a nomograph designed is only worthwhile if the computations for which it was made are repeated frequently.

A nomograph for the solving of a particular equation can take many forms. The one shown is only one possibility and was selected because of the ease with which it could be solved. (None of the lines overlaps.)

[1] Production Handbook — L. P. Alford & J. H. Bangs; Ronald Press Co. Procurement — H. T. Lewis; R. D. Irwin, Inc.



NOMOGRAPH FOR COMPUTING STANDARD ORDERING QUANTITY

One Approach to Incentive Systems for Maintenance Workers

Attracting skilled maintenance workers is prime reason for bonus systems, says the author, whose experience in union negotiations, plant engineering, and maintenance qualify him to talk out loud about this problem

By TOM ADAMS, Member, Incorporated Plant Engineers

AN IMPORTANT REASON for incentive programs for maintenance workers is the essential need to attract the highest possible skills to maintenance departments, particularly in view of the increasing trend to highly complicated production plants.

As our company had previously carried negotiations a long way with the unions in the matter of incentive bonus schemes and had in fact successfully introduced such schemes for the production operatives, the maintenance departments began to press very hard through their own representatives for some acceleration in their own sphere. This, of course, was not unnatural, seeing that agreements had been reached that they would eventually be included. Although considerable investigations had already been carried out, it was apparent that the original schemes must be reviewed and that the time had arrived to expedite matters, even to considering some temporary method of payment.

Now, where do we begin our approach to the problem? Like so many others faced with similar problems, it is not unnatural that we should turn first to past history and study all that has been tried or proposed on this subject, both outside and inside one's own industry and not to throw aside any scheme without first analyzing it in relation to one's own situation. Incentive schemes date back as far as the 1700's and 1800's, and are associated with the names of Perronet and Taylor. The more modern systems that most of us here have heard of, are, of course, the Bedaux, Halsey and Rowan systems.

It is safe to say, however, that these are mostly related to production workers and depend very largely on a highly repetitive element in any work load, where, in particular, full use can be made of time study methods.

Our company's original intention was first to establish a system of Planned Maintenance which would then be followed by introducing an incentive bonus scheme based on time studied principles.

It was, however, evident after several months' experience that this procedure would cause considerable delay in the application of incentive payments. In order to hasten this application, it was decided to investigate the possibility of introducing incentive payments without waiting for the completion of planned maintenance routines and if workable, to rely in the early stages on a scheme or schemes based on estimated times, with a broad cover of time study. It is not, however, intended to discard the original intention, that is, to pursue planned maintenance as time permits and as a permanent long term policy. Indeed, from experience it has been established that the two are complementary.

In deciding to adopt the estimated time schemes, it was very important and necessary to get to grips with the maintenance bogey — the low rate of repetitive elements. In early discussions it was claimed in certain quarters that these elements were as high as 80 per cent; subsequent experience proved them to be the direct opposite. While this might be disputed, the early months of the investigations substantiated this figure. As time goes on there is no doubt though that this proportion will tend towards the higher figure. One further complication in this respect was the fact that the repeats were often spread over such long intervals, that time study was of little or no help.

Investigation

What then are we to establish in its place? The obvious answer, I think, is job or work study, bringing into full use the highly skilled trades foreman. It is most essential that such foremen be carefully selected to insure that long experience and accumulated knowledge can play their true parts in the break-down of the work and in formulating rigid specifications. It was therefore accepted in the earliest stages of our investigation that the right type of personnel were a necessary adjunct to our efforts.

The accepted practice has for many years been that with skilled craftsmen, job break-down and specification is not necessary. The further we proceeded in the investigation, the more apparent it became that much time was spent on matters and incidentals that could easily be spent on the job itself, if pre-planning were brought into play. In other words, to use an electrical term,—"take care of the wattless energy and so improve your power factor."

Another fundamental was also established as the investigations proceeded, and that was the need for tolerance and co-operation with the labor concerned. It is true to say that in the past the majority of attempts at bonus schemes have completely failed, due to lack of co-operation between workers and administrative staff. With this in mind, every endeavor was made to introduce simplicity into our negotiations, realizing that in breaking new ground, one could afford not to expect the perfect result; at all times trying to avoid imposing on the worker any complicated system of reckoning either times allowed or bonus earned, because this, more than anything else induces much time wasting and distrust.

Our next step was to select and train Ratefixer-Specifiers, and these were first-class craftsmen. In order to obtain a uniform pattern of timing (i.e. speed of working in addition to skill), they were given instructions in preliminary timing of jobs in order to assimilate the basic ideas of speed of working. At a later stage, their training took them on to specification of work — this being done in conjunction with the foremen.

Finally it was established that as far as possible the scheme should be based on estimated time for individual jobs; payment would be on a straight line system, with a ceiling

on bonus earning for each job of 50 per cent. This safeguard was necessary in order to control any loose time estimates that might be evident in the early stages of introducing payments.

Tradesmen attached to process departments, were to be left out of the individual scheme and dealt with by routine or preventative maintenance schedules.

Our broad pattern thus was Planning, Progress and Ratefixer Specifiers.

Collection of Data

In order to attack the problem on simple principles, it is of course necessary to obtain as much relevant information as possible, and in order to do this, a "dummy" run was inaugurated to establish the paper work. Don't be put off by this statement. Proper work is not altogether the bogey we engineers have thought it to be. In the early stages it may appear a bit cumbersome, but time will whittle it down and much useful information will be brought out.

For this run, data cards were issued to the tradesmen, who furnished information relating to work performed, equipment and materials required, the waiting time for unforeseeables and time wasted due to lack of the right tools. As these cards were returned the Planning Engineer was brought into the scheme. It was his job to analyze, criticize, correlate and discuss with whoever was concerned, and finally recommend job specifications and evolve the correct form of instruction cards.

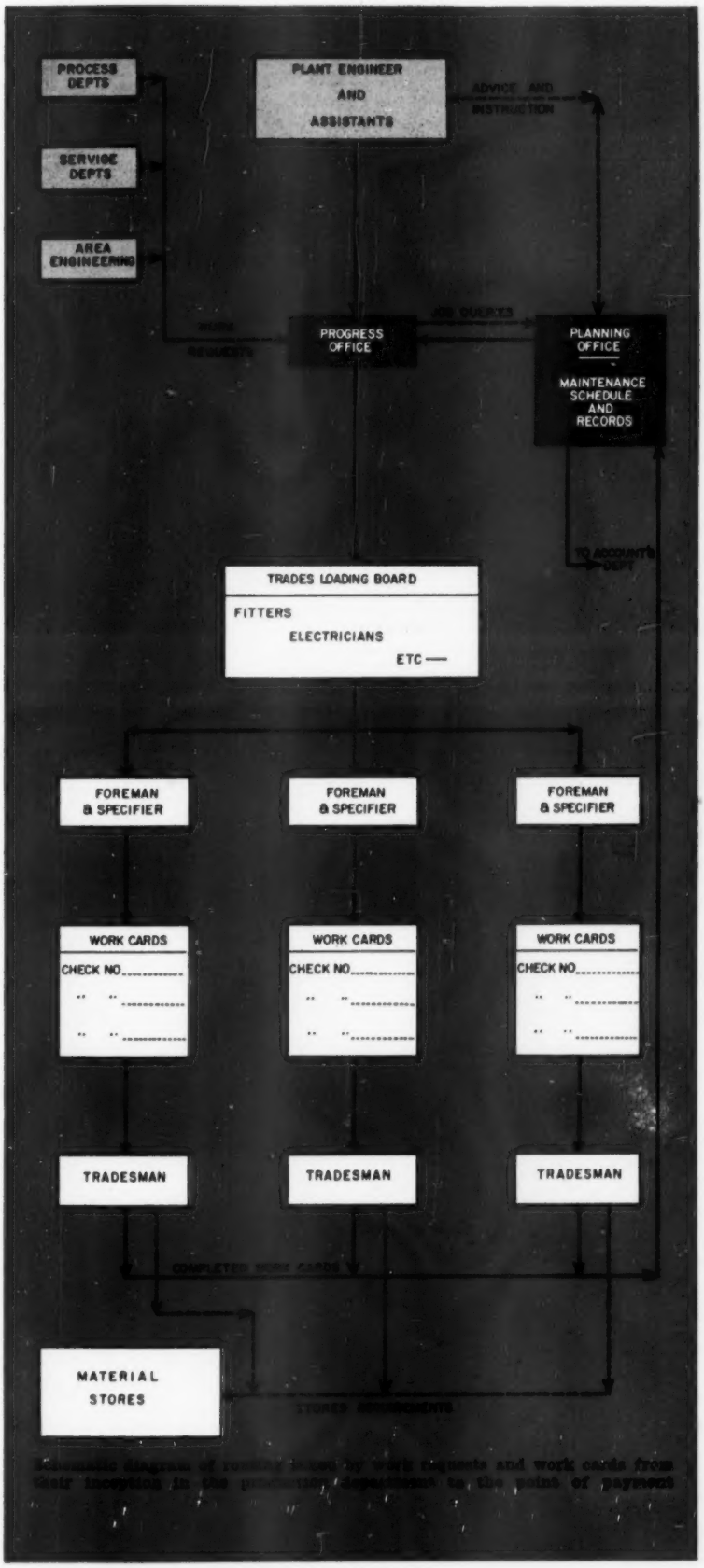
Much useful information has, over a period, been gained in forming manuals of the variables one associates with maintenance work, from the data supplied. These variables are referred to also as synthetics.

Work Request Routing

To enable the "dummy" run to succeed, it was early evident that there must be organized routing of work requests, and to this end a Progress Clerk was established under the guidance of the Planning Engineer. All departments — both Production and Services—were instructed to send their work requests to this central point, with the exception of the departmental tradesmen, and at this point the work was selected under the various trades headings and passed on to the trades foremen.

Where several trades might be involved, the trades foremen were notified of their own particular job with reference that other trades (named) were also involved. Where several trades were involved on any particular job, the Planning Engineer would lay down the sequence in which they carried out their own

(Continued on page 140)



Schematic diagram of routing taken by work requests and work cards from their inception in the production departments to the point of payment

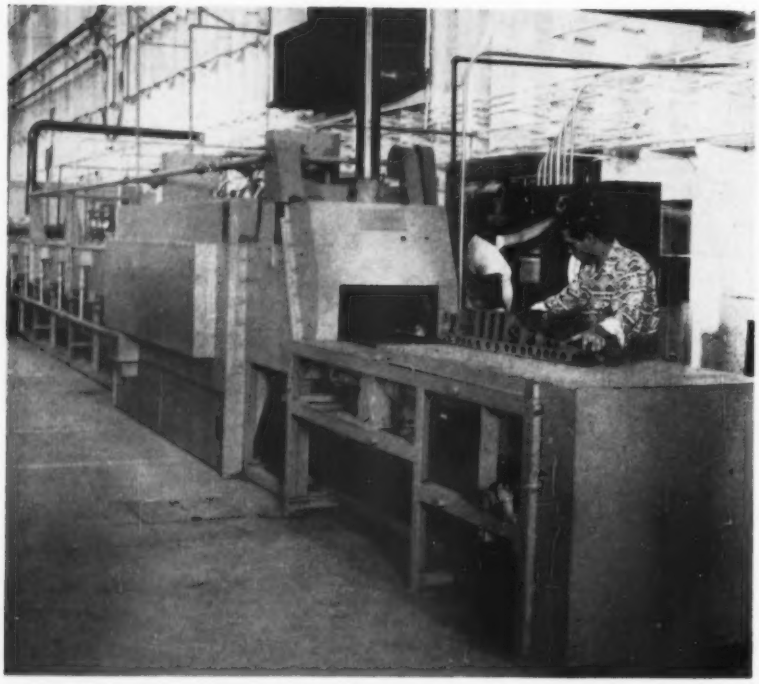
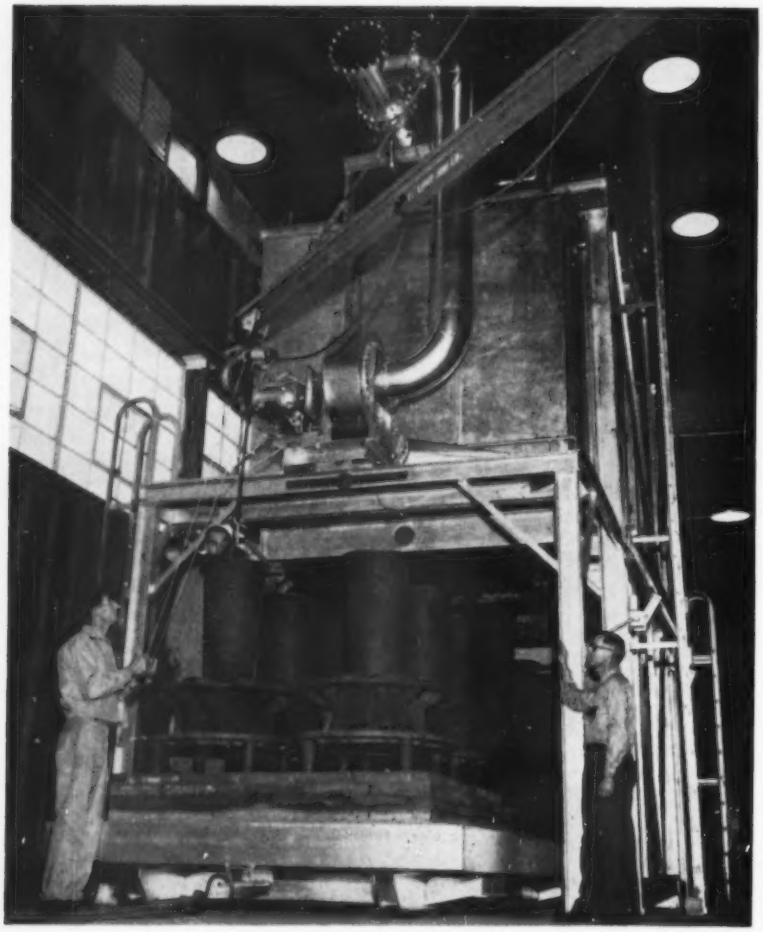


Fig. 1. Rocket motors are stress relieved in this 52-ft-long continuous furnace

Fig. 2. Loading car is hoisted 9 ft into this automatic electric furnace



Four Types of

FOUR LARGE, NEW furnaces, each different in design, have been installed recently at Ryan to "put the heat on" jet engine components. Including a towering second story model with an elevator bottom and a 52-foot long tunnel type, these unusual furnaces point up the importance of heat treatment in Ryan Aeronautical Co.'s prodution plan.

Augmenting the present array of nine heat treating furnaces, the new facilities will be used to stress relieve Ryan afterburners, rocket motors, aft frames and other jet engine components. The installations are the most modern types, especially tailored to meet the exacting tolerances and fine finishes of jet power plants.

Largest and most efficient of the new furnaces installed at Ryan is the General Electric-built model used to stress relieve aft frame sections for jet engines. This two-story furnace contains a brick-lined heating compartment which is supported on steel columns nine feet above the factory floor. An ingenious loading car, containing ten aft frames, rolls under the furnace and is hoisted by electric motors to form the furnace bottom. By loading vertically, through the bottom of the furnace, heat losses are reduced to a bare minimum.

Continuous Conductor

Heating is produced, electrically, by a continuous conductor which is coiled in the fire brick interior of the furnace. Sealing of the furnace bottom is effected by means of a knife-edge metal strip, running along the bottom of the furnace, which descends into a sand trough located along the periphery of the car. The sand seal is designed to be air tight for the normal pressures of 1½ in. of water but will blow out in the event excessive pressures accumulate in the interior.

Most metals oxidize when heated in air. The oxidation attack rate increases as temperature rises and occurs with varying intensity over the surface. This discontinuity of attack is due to the anisotropic properties of the crystals which present different faces to the exterior and, consequently, exhibit varying degrees of chemical reaction. As a result, oxidation produces a rough, uneven surface accompanied by loss of metal even though the oxides are completely removed by acid bath

Furnaces Needed Here for Heat Treating

Basically they all do the same job but their sizes, shapes and manners of doing it are radically different . . . Plant engineering designed and built special quick-loading mechanisms

treatment. Naturally, this phenomenon cannot be tolerated in jet engine components where metal surfaces must be smooth, true and held within a few thousandths of an inch.

To prevent oxidation of the aft frame sections while they are hot, this furnace is purged of all oxygen and filled with a neutral atmosphere during the entire heating and cooling cycles. This is accomplished by a special gas generator which partially burns city natural gas until its oxidizing agents are removed. Then, with the furnace sealed, the neutral atmosphere is pumped through for forty five minutes prior to heating, to remove all air. Excess gas passes through a vent in the furnace bottom which is closed after purging.

With purging completed, the automatic electronic controls are set and the entire heating and cooling cycles are accurately regulated without employee supervision. Usually, temperature is brought up at a steady rate of 200 F per hour until 1650 F is reached. This temperature is held until the stress relief is accomplished and the furnace is cooled at a regulated rate prescribed by metallurgists. Normal cooling can be augmented by passing the circulating atmosphere through water cooled tubes.

Because the furnace is heated electrically it can be completely sealed without the necessity for disposing of products of combustion. Temperatures, pressures and atmospheric conditions are completely under the control of the operator. This command also extends to the cooling phase which is equally important in stress relieving structures of very close tolerances. Slightly too rapid cooling can induce new residual stresses. Sudden cooling could cause residual stress by thermal shock which would be just as harmful as the stresses previously removed by the heat treatment.

Undoubtedly, the most unusual new furnace to come to Ryan is the Lindberg continuous model. Made by the Lindberg Engineering Company of Chicago, Illinois, this unique unit is designed to perform heating and cooling simultaneously, in separate compartments. Parts are fed into the facility by means of an endless chain conveyor belt which passes over steel drums that are rotated by electric motors.

The hottest heat treating furnace at Ryan, the Lindberg unit can operate at 2100 F and may be used for furnace brazing. It is heated electrically through Globar heating elements which are spaced above and below the conveyor in the heating compartment. After passing through the heating chamber, the belt carries parts through three successive cooling compartments in which the temperatures and atmospheres are also controlled. Cooling is effected by water circulating through surrounding jackets.

Controlled Atmospheres

Oxidation is prevented by controlled atmospheres which are generated and pumped through all parts of the furnace. These gases are obtained by partially burning natural gas and passing the products over a catalyst to enrich them in hydrogen and carbon monoxide. Because of the heavy concentrations of these gases, the atmosphere obtained is actually a reducing gas which will remove oxides as well as prevent their formation. Black, oxide-coated steel can be run through the furnace to emerge as a bright, shining metal.

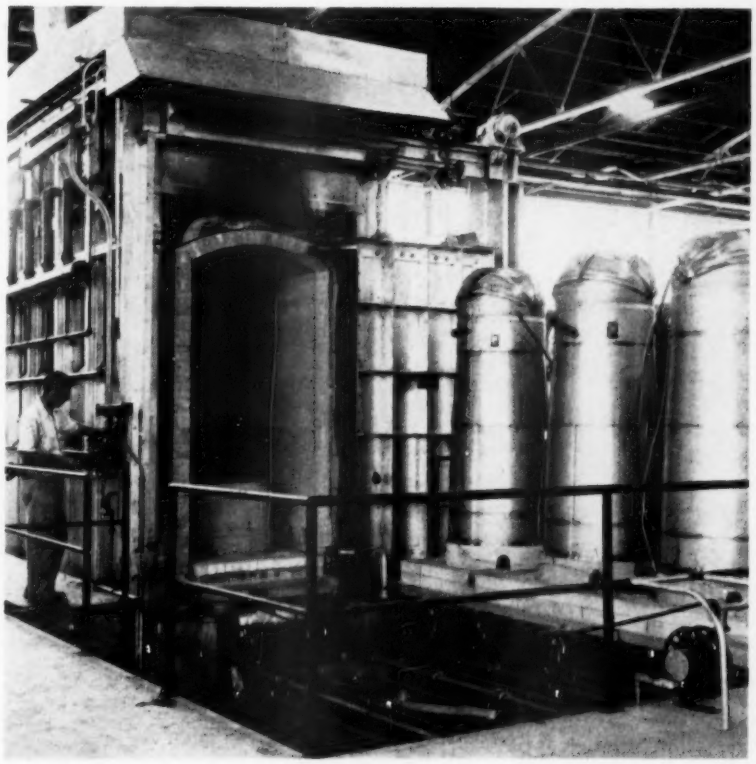
By continually charging the Lindberg furnace with controlled atmospheres an internal pressure of approximately 2 in. of water is created which prevents air from entering. Although there are doors at each end, the furnace may be operated with these open and fibre glass curtains used to prevent the emergence of flames.

Ryan is using the Lindberg furnace to stress relieve rocket motors which must be built to minute precision and completely "relaxed" before beginning their short but spectacular life.

Because they are substantially larger than other jet engine components, Ryan afterburners posed a special problem in heat treating. This was resolved by Industrial Systems, Inc. of Los Angeles, California, who designed and built a large gas-

(Continued on page 142)

Fig. 3. This furnace was specially designed for treating and relieving afterburners



Pictured here is a typical application of motor equipped with sleeve bearings

BEARING MAINTENANCE for Industrial Electric Motors

This first of two parts on motor bearing maintenance covers step-by-step job of rebabbitting, pressing-in, sealing and operating sleeve bearings. Part two will cover maintenance of industrial motor ball bearings

By J. W. SAMZELIUS, Mechanical Engineering, Westinghouse Electric Corporation, Buffalo

TO REDUCE THE maintenance problem and increase the dependability of electric motors during ever increasing demands for higher speeds, higher loads, longer hours, and greater temperature variations, much engineering effort has been expended on the design of motor bearings. The result is that, today, millions of bearings are practically maintenance-free during many years of successful operation.

The following recommendations apply to standard motors of industrial sizes. Large motors and motors in special applications may require special instructions for their maintenance in this field.

In the standard motor the bearings must be of a design most satisfactory to the majority of service conditions. However, in a motor designed for a definite purpose the bearings may be selected by the designer to suit and instructions for proper maintenance should then accompany the machine. These factors give rise to two major types of bearings—the ball bearing and the sleeve bearing.

Through experience it has been found that the ball bearing is the type of bearing that most completely meets all the demands from the designers and users of electric motors and, therefore, this type has been adopted by all manufacturers for their standard lines of motors.

Ball bearings have acquired this reputation through many attributes:

1. A ball bearing has high thrust capacity in addition to radial capacity, therefore it allows the motor to be mounted vertically or in inclined positions and permits heavy external thrust loads.

2. It has uniform capacity around the periphery, therefore, power may be taken off by belts or chains in any direction.

3. It takes comparatively small space, therefore, dimensions become smaller and the ventilation openings can be larger and better protected.

4. It can be lubricated by grease; this eliminates oil leakage and thereby reduces the danger of insulation failure. This also tends to make the installation tidy and clean.

5. The bearing is not subject to wear, therefore, the airgap will remain constant.

6. Frictional resistance is low and periodic oiling or greasing is comparatively infrequent, therefore, the maintenance is somewhat less costly.

These characteristics are so valuable in the design and application of the standard electric motor that the few advantages held by the sleeve bearing hardly need be considered in standard motors.

It should not be concluded that the sleeve bearing is an outmoded bearing in all applications, however, for it will definitely continue to be used in large machines of high speed and in many special applications where its advantages are of importance. (One such application involves the use of split bearings. Ball bearings cannot, for obvious reasons, be made in two semicircular halves and are therefore not considered in such a case.) Also, until recently it was rightfully assumed that sleeve bearings run more quietly than ball bearings.

However, improved methods of finishing the ball bearing parts already challenge this asumption and may, in the near future, place the ball bearing in a strong competitive position for quietness. Another reason why some people favor sleeve bearings is that a good mechanic can repair or make a new sleeve bearing from materials and tools found in the average machine shop.

Part 1—Sleeve Bearings with Oil Ring Lubrications

MOST SLEEVE bearings of less than six inches diameter are babbitt-lined steel shells cast by the centrifugal method. The lining, which is comparatively thin (1/16 or even 1/64 in.), is bonded to the steel shell with a solder bond and will not peel loose even after it is very worn.

Larger bearings and split bearings are often made from cast iron shells with a lining of babbitt. Since it is difficult to obtain a solder bond on cast iron, the lining is usually anchored to the shell by means of dovetails or anchor holes. To obtain sufficient strength in the lining between the anchors, the lining must be made quite thick and is often ¼ in. or more.

A heavy lining is not desirable when the unit bearing load becomes high or is in the nature of shock. Such loading tends to pound out and deform the thick lining and cause failure by cracks and fatigue. Plain bronze bearings or very thin babbitt linings in steel or brass shells are best for shock loads.

Babbitt lining may be the tin base type that contains 80 to 90 per cent tin, with the remainder about equally divided between copper and antimony. It can also be a lead base type containing from 75 to 85 per cent lead, with 5 to 10 per cent tin and 10 to 15 per cent antimony as the other major constituents. Either type of babbitt will make good bearings for general purpose applications, but the tin base babbitt is preferred where the atmosphere is apt to be corrosive.

Rebabbitting Method

Recommended procedure in re-babbitting a bearing is to pour the babbitt oversize (undersize mandrel) to allow a boring operation to size. Both bearing shell and mandrel must be pre-heated to approximately the temperature of the molten babbitt and all openings in the shell must be sealed up. Cotton waste, moistened in water, can be used to seal the openings in smaller bearings.

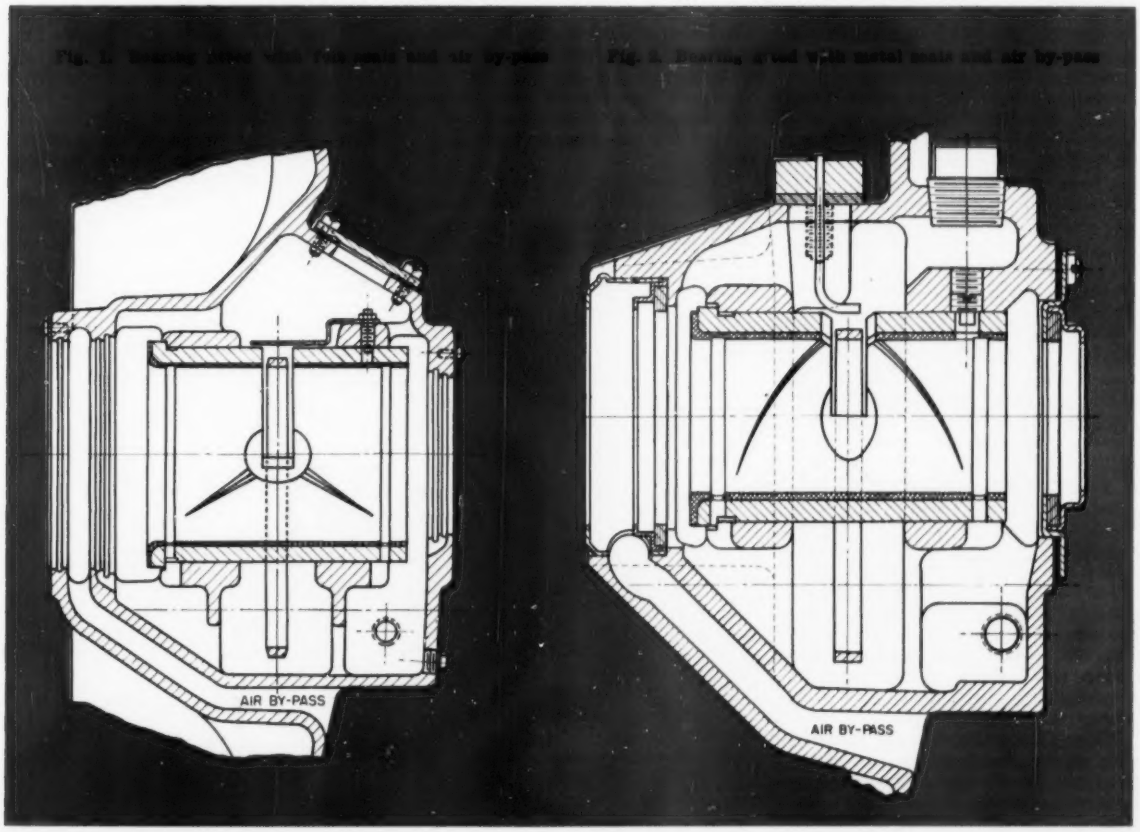
Asbestos fibres might be safer for sealing large bearings, but care must be taken that none of this abrasive material is left where it can cause trouble in service.

All steel or brass shells having a bonded lining must be tinned prior to pouring the babbitt. When the re-babbitted bearing is bored it must be lined up very carefully to obtain concentricity with the outside surface which is already finished.

In rare cases the bearing may be cast to size without boring. The mandrel must then be made to the size of the shaft, or the shaft itself might be used as a casting mandrel. The shell and the mandrel must be lined up very carefully to obtain concentricity and alignment. In order to withdraw the mandrel easily, and at the same time obtain approximate running clearance, the mandrel may be coated with white lead. Local high spots or roughness may be removed by scraping; oil grooves of similar pattern as the original are cut by hand.

When pressing a solid bearing into the bracket housing, the bearing may distort or even collapse at the weak section left by the oil ring slot if the press fit is too tight. To reduce the force required for pressing in the bearings, standard bearings are often made with a slight taper. The pressing mandrel should fit the bearing bore and have a flange that extends over the entire thrust face. The oil ring, which must be in place in the housing before the bearing is pressed in, should be first inspected for roundness.

If it is oblong or shows worn spots it may fail to revolve uniformly with the shaft, and then the bearing may fail from lack of lubrication. The oil ring must also be watched during the pressing-in of the bearing, since it may interfere with the bearing and become damaged. When the bracket is assembled on the shaft it should be turned to an upside down position since this



will prevent the oil ring from interfering with the shaft.

If the bearing housing is sealed by felt washers at the ends, these washers should be replaced when new bearings are installed. If the regular style felt washer is **not** available when needed, a satisfactory washer can be cut by the repairman with a thin, sharp knife, providing a good grade of felt is available. Since it is important that the washer fit snugly around the shaft without being tight the following method is recommended for cutting the felt:

First: Determine the exact inside and outside diameter of the washer. The inside diameter should be no no larger than the shaft at the point of sealing.

Second: Turn up two discs from hardwood to these diameters. The discs can be as thin as ¼ in. and should not be more than ½ in. thick. Drill a central hole for a snug fit of a ¼ in. or ⅜ in. bolt through each disc and cut a hole admitting the same bolt through a suitable piece of felt.

Third: Sandwich the felt between the two discs and clamp the pieces together with the bolt and a nut. The felt washer can now be cut to the proper size with a sharp knife by following the edges of the wooden discs. The clamping bolt will assure concentricity between outside and inside edges.

Felt washers are not supposed to prevent oil from leaking out if the oil level is too high or if the machine is inclined. Their main purpose is to prevent strong air currents from passing through the housing and thereby to keep oil mist from being drawn out and airborne dust and dirt from entering the housing.

Another way of reducing oil leakage, caused by a difference in air pressure at the ends of the bearing, is to provide an air by-pass in the bearing housing. Bearings of newer design are usually made with such a by-pass. (See Figures 1 and 2.)

Before assembling the bracket with the shaft, the thrust face of the oil thrower should be inspected and if it appears rough, should be polished smooth. The outside corner of the oil thrower should also be rounded off slightly since a sharp corner may damage the felt seal when the bracket is assembled. The bearing journal should be coated with oil before installing the bracket in order to permit the rotor to be turned by hand for a preliminary check of the line-up. This precaution may save time and trouble if something is wrong that makes it necessary to remove the bracket. It will also protect the bearing.

When filling the bearing housing with oil for the first time it is all-right to fill through the oil ring sight hole if the oil-level control plug at the side of the housing is open and the oil cannot rise above its normal level. All later refilling should be made through the oil-level plug, and preferably while the motor is at a standstill. If it is necessary to oil while the motor is running, care should be taken that not too much oil is added and that no oil is spilled where it may be sucked into the motor and onto the winding.

If a rotor with 5-in. diameter bearings or less does not turn over freely by hand, the bearings are probably misaligned and need adjustment. Close examination of the clearance condition around the outer end of the bearing, either visually or with the aid of a thin feeler gage, may reveal whether the bearing is misaligned or whether adjustment of the clearance is required.

If the shaft is carrying the load from a belt, it is possible that shaft deflection inside the bearing will cause very high local loading at the outer end of the bearing. The softness and non-wiping properties of babbitt will often relieve such concentrated loading automatically but bronze bearings may require scraping to attain wide load distribution.

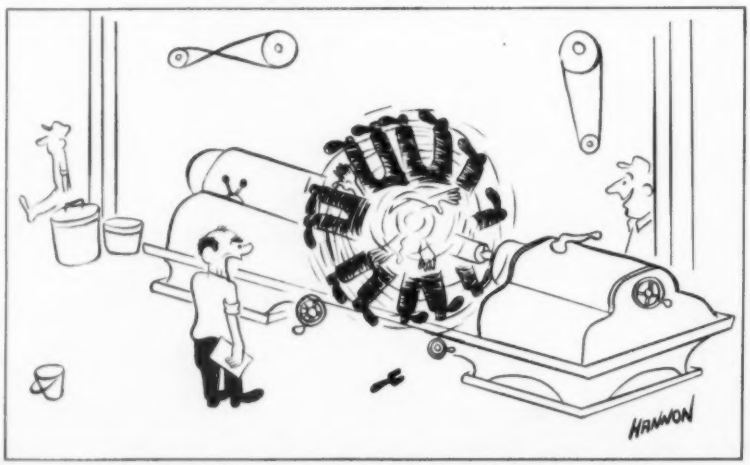
Diametrical clearance in the sleeve bearing should be in the order of 0.002 in. per inch of diameter, or slightly more for small bearings. The viscosity of the oil must be selected to suit the clearance provided and therefore it may be advisable to use a heavier oil after the original clearance has increased due to wear. Since proper working of the oil ring also depends on the viscosity of the oil it is necessary to assure that the oil ring supplies oil in sufficient amount after a change has been made to a heavier grade oil.

All sleeve bearings have very low thrust capacity, so if the bearing being replaced shows exceptional wear on the thrust face it might be necessary to eliminate some of the conditions causing wear.

If the thrust shoulder on the shaft appears rough, it should be smoothed off. If there is doubt about the thrust face receiving sufficient oil, it might be necessary to restrict the drainhole in the bottom of the bearing at the thrust end. If external heavy thrust is causing heat and wear, the thrust must be reduced. If the thrust is due to an unbalanced condition of the magnetic center, the rotor may be shifted on the shaft.

Any normal sleeve bearing motor should show very little thrust when run at no load. If the rotor runs to one side it should be possible to push it away with a light force. If the rotor shows a tendency to bump against the bearings, the reason is probably that the thrust shoulder on the shaft is out of square and is receiving a glancing blow every time it contacts the bearing. This condition must be corrected by taking a cut off the shoulder. Reactive forces from internal fans or winding windage may be sufficient to carry the rotor over the one side or the other. In such a case a change in the direction of rotation will probably cause a reversal of the thrust, but the forces involved are usually so small that the bearings readily can sustain their action.

In applications employing gear-type flexible couplings, the bearings sometimes become loaded by high thrust caused by the coupling. The reason is that a liberal end float in the coupling permits the coupled shafts to shift their position relative to each other when the coupling is not transmitting torque. When the coupling is loaded, the friction is greatly increased and the shafts become more or less fixed in their axial positions by the coupling. If this fixed position should happen to leave very small clearance against a thrust shoulder, a subsequent expansion in the shaft due to heat may take up all the remaining clearance and load this thrust shoulder to destruction. To minimize troubles from this source, the end-play in machines applied to coupled service may be made extra large.



"Alright, Philcheck, that's enough clowning for one day!"

Moving Heavy Machines by Crane and Truck

In the plant the engine is securely blocked on the truck; later it will be well bound with chains

Crane-Truck method of moving engines cut placing time to 1½ hr at point-of-installation . . . Only 15 minutes needed for placing smaller engines . . . Figures show that 10 days' erection time was saved for the customer

ONE OF THE most recently built and most easterly stations of the Tennessee Gas Transmission Company is located in Eden, N. Y.

There are four Worthington Uniflo type UTC 165 two cycle angle gas engine compressors, each unit capable of pumping 43,000,000 cu ft of gas every 24 hours from 400 psi as it enters the station, to 700 psi as it is sent on along the line. Each of these engines weighs over 40 tons, and there are also three smaller or auxiliary engines which weigh approximately 22 tons each.

In previous similar installations the engines used have been moved on trucks or railway flat cars and put in position at the station by means of jacking, rolling and cribbing. Aligning the engines on the piers required several days' time, even the smaller engines taking at least two days for this work.

When the arrangements were being made with Worthington for the Eden equipment C. H. Stevenson, superintendent of the Eden station, suggested that the engines be moved the twenty miles from the Buffalo Worthington plant to the new station by truck. William Higgins & Co., riggers and haulers, decided to do it with a crane, thus providing the first such materials handling method ever used for a Tennessee Gas installation.

The 14-ft-high piers were completed at the station before the engines were moved. Each pier contains 100 sq yd of concrete and has twelve anchor bolts set into it to secure the engines. To move these engines without a crane would have made it necessary to carry two truckloads of blocking and other equipment. By using the crane all this was eliminated, the engines were moved intact and placed in perfect position on the piers. About an hour and a half was needed to set up each large engine and only about fifteen minutes for the smaller ones, and a perfect level was obtained for each machine. Mr. Higgins says that at least ten days were saved by using the crane.

The truck used to carry the engines to Eden was a 100-ton job. The crane was a 50-ton, capacity crawler crane.

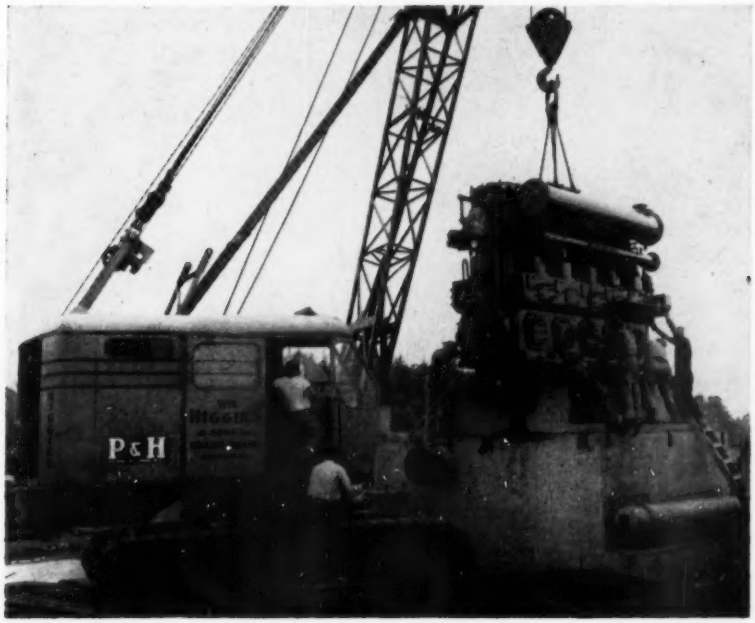
Four large eye-bolts were set into the top of each engine and heavy bars run through them, to which a cable sling was attached. The operation then was that an engine was loaded on the big truck at the Worthington plant, fastened securely by chains and wrapped in heavy waterproof paper, which was also held tightly in place with tacks and rope.

Upon arrival at the Eden plant the engines were removed from the trucks and set in place on the piers. It was really as simple as that. The only Higgins' employees who participated in this operation were the truck drivers and the crane operator, all the work of actual installation being done by Tennessee Gas employees. This method meant, therefore, not only a great saving in time, but a corresponding saving in costs.

Both Worthington and Tennessee Gas people were pleased with the work done. Worthington has since moved other similar equipment in this same way and the gas company plans to use such services, also, for future installations.

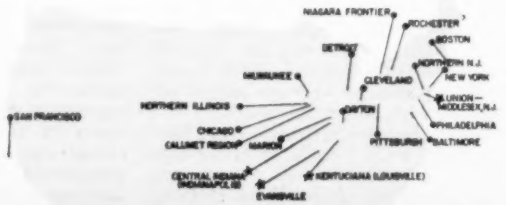
The engines were placed before a building was erected to house them. This facilitated their handling as the crane could thus work in the open. As soon as the engines were in place final connections were made and a neat, 42 by 120-ft building was erected over them. All this took less time than it would have taken to just set up the engines by former moving methods.

The crane lowers the engine into place. It is aligned on the block with shims by means of transit. With the help of the crane a perfect level is easily obtained



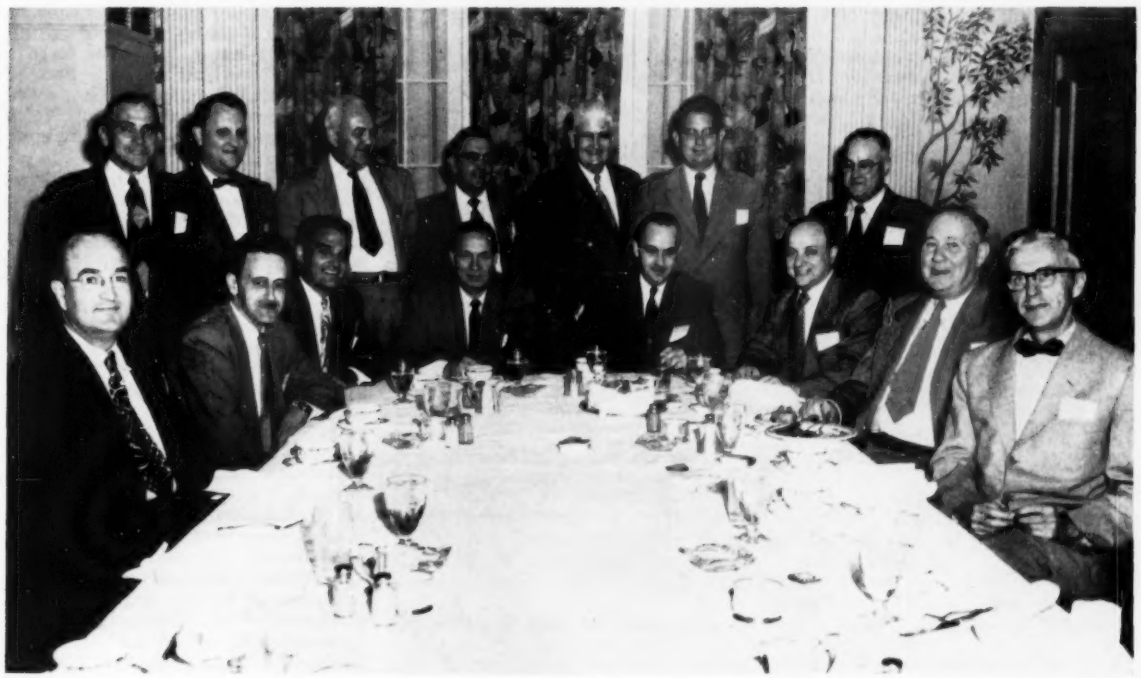
Members and guests present at first meeting of Plant Engineers' Association Union-Middlesex Counties, on October 6. First row, left to right: E. R. Wilkinson, Standard Oil Co.; T. E. Klein, E. I. du Pont Co.; W. O. Brown and W. G. Hughes, Heyden Chemical Co. Second row: W. N. Pratt, American Metaseal Corp.; Andy Anderson, Plant Engineering magazine; R. Austin, American Cyanamid Co. (program chairman); Mr. Evans, American Metaseal Corp.; E. Meyer, U. S. Metals Refining; J. Tammaro, National Lead Co. Standing: R. G. Thiede, General Aniline Works; Rocky Marinello, Plant Engineering magazine; L. Woolfenden, General Aniline Works (president); S. Whitehead, American Cyanamid Co.; J. Sutherlin, Merck & Co., Inc.; I. R. Lewis, Merck & Co., Inc. (sec.-treas.); C. Hall, National Lead Co.

Four Stars Added to P. E. Societies' Map



Plant engineers present at the organizational meeting of the Central Indiana Plant Engineering Society on October 19. Left to right: J. K. Keys, Indianapolis Bleaching Co.; C. L. Turner, Citizens Gas and Coke Utility; G. Schulz, Citizens Gas and Coke Utility (temporary chairman); Tom Hanson and Rocky Marinello, Plant Engineering magazine; J. Erwin, Western Electric Co.; P. Simmonds, International Harvester Co. (program committee); and W. A. Klein, Firestone Industrial Products Co. (temporary secretary-treasurer). The next business meeting is scheduled for November 19 at which time the group will consider adoption of a constitution and by-laws. Each man present at this initial meeting will bring another plant engineer from the Indianapolis area to "sit in" on business discussion at the November meeting

Plant Engineers from the Louisville area present at the organizational meeting of the Kentuciana Plant Engineers' Society, on October 21. Left to right: J. M. Gloor, Tube Turns, Inc.; O. B. Van Hise, P. Lorillard Co., Inc.; M. J. Hurd, Schenley Distillers (temporary secretary-treasurer); Tom Hanson, Plant Engineering magazine; M. F. Reich, P. Lorillard Co., Inc.; C. C. Bassett, Belknap Hardware and Manufacturing Co. (temporary chairman); J. H. Murrell, Ford Motor Co.; P. J. Sehlinger, American Air Filter, Inc.; E. R. Lott, Buckeye Cotton Oil Co.; J. S. Case, Tube Turns, Inc. (constitution chairman); Rocky Marinello, Plant Engineering magazine; J. L. Hauschildt, Buckeye Cotton Oil Co.; and B. Head, P. Lorillard Co., Inc. The next meeting of the Louisville group is planned for November 17



Organizational meeting of the Evansville plant engineers was held on October 22. Seated, left to right: J. Lafferty, L. Berman and Co., Inc.; Tom Hanson, Plant Engineering magazine; P. Rhodes, Kent Plastics Corp.; N. L. Kniese, Evansville Manufacturers' and Employers' Association; C. M. Swaim, Hoosier Cardinal Corp. (temporary chairman); Rocky Marinello, Plant Engineering magazine; J. C. Starnes, Faultless Caster Corp. (chairman, membership committee); and W. F. Clancy, Bucyrus-Erie Co. Standing, left to right: J. Heumann, International Harvester Co.; W. L. Winternheimer and G. E. Miller, Chrysler Corp.; H. Gill, Kent Plastics Corp.; F. Zaieck, H. Fendrich, Inc.; H. Sitton, Swift and Co., and L. J. Dagley, Sterling Brewers, Inc. The Evansville group also plans to hold their next meeting on Nov. 17

Reprints of Entire Lighting Series Available — Last Chance!

Reprints of this series of twelve articles will be available the first of next year. Readers who wish to receive a reprint of the entire series may do so by writing to The Editor, Plant Engineering, 110 South Dearborn St., Chicago 3, Illinois. First reprint is free, additional copies $1.00 each.

12 ....

Procurement and Inventory Of Industrial Electric Lamps

By LEONARD V. JAMES, Fellow I.E.S., Illuminating Engineering Consultant

FEW FACILITIES in plant operation are more important than the lighting, for which the right lamps must always be available as needed. This seems so simple a management problem, in the presence of the many difficult situations confronted each day, that little thought need be given to it. That may well be the case if the procurement procedure has been carefully planned.

The plant engineer, purchasing agent and general manager all have important parts in this planning. The plant engineer should make sure that the lighting fixtures used require the smallest number of types and sizes of lamps that is practical. He also should be sure that these lamps are the most satisfactory from an operating standpoint. He will be particularly interested in all of this if he has charge of the supply stock room.

The purchasing agent is responsible for placing and securing prompt service on the orders, while he may also supervise the stock operation. Since he does not control what is required in the plant, he should keep the manager and plant engineer informed as to price changes and the availability of new and improved types.

The general manager should make sure that all of this is functioning in a manner that will be most satisfactory for the over-all operation of his plant.

One of these executives would assist the stock clerk plan his operation so as to assure prompt service without a large investment.

General lamp types have been discussed rather thoroughly in earlier articles* in this series. All of these types will not be used in any one plant. In fact, there is an economic advantage in keeping the number of types low. This should not, of course, prevent trying out different types, particularly improved lamps as they become available, and their substitution or addition in the system. This should be done, however, only where a complete analysis indicates this action is justified.

It is true that lamp selection influences the entire cost of owning and operating the lighting system (and affects indirectly the plant operation). Despite this fact, lamp cost itself is but a part and proba-

bly a small part of the cost of light. The complete comparative economic picture to be studied includes lamp cost, normal lamp life, lamp replacement cost, watts consumed and mean light output throughout life. To this should be added incidental fixture, wiring and maintenance costs.

In general, lamps with long life should be installed in the not easily accessible places. Long life is not always a good characteristic, however. If such lamps are used for productive lighting and the depreciation is severe due to the long life, an excessive number of lamps may have to be installed initially to compensate for this. Usually long life lamps means fluorescent, although frequent switching, if this is necessary, will shorten the life of these lamps.

Fluorescent lamps are also highest in efficiency in light output per watt. The 96 in. T12 standard cool white slimline lamp, for instance, is rated at 67 lumens per watt consumed by the lamp and 56 lumens per watt including the loss in a standard series type ballast.

This compares with 58 and 50 lumens per watt, respectively, for the 90-watt T17 standard cool white lamp. It also compares with 47 and 42 lumens per watt, respectively, for the H400E1 mercury lamp and 19.8 lumens per watt for the 500-watt incandescent lamp.

The relative list prices of these lamps are $3.50, $2.55 (the 90-watt lamp also requires a $1.00 starter), $17.00 and $.95 respectively. However, per 1,000 lumens delivered and per 1,000 hours of life, these prices become 9.5 cents for each of the fluorescent lamps, 19.9 cents for the mercury lamp and 9.6 cents for the incandescent lamp. Some other mercury lamps would be lower, so far as the lamp prices alone are concerned.

The above figures are not particularly significant if used without also considering the cost of energy, the number of outlets required to be wired and maintained, etc. A matter of perhaps greater significance in comparing the two fluorescent lamps is the number of feet of fixtures required to give the same light delivered. This is 16 ft with the slimlines for each 10 ft with the 90-watt lamps.

In the above case, it is of course possible that the greater number of fixtures with slimline lamps will provide a better distribution of the light. Also it is true that the 96 in. T12 slimline lamp is less bright than the 90-watt T17, which means less objectionable reflections from working surfaces for the longer lamp.

The kind of information that is available and valuable in comparing lamps is shown for a few common types in the table. The lamp cost there should be increased in a specific case by an amount to cover replacement expense. Were this the same per lamp, the result would be to penalize the incandescent bulbs because of the number of these

*See PLANT ENGINEERING for Feb., Mar., Apr. and May, 1953.

lamps handled. On the other hand, to have included fixture costs in the cost of light would have penalized the fluorescent and mercury lamps. Both of these influences would be small, however, in the presence of the energy cost, except where the rate for the latter is very low.

Continuing consideration of the table, it would be interesting to ascertain at what discount inferior 40-watt T12 fluorescent lamps would have to be purchased, with an assumed 5 per cent lower maintained efficiency in light output per watt, if the over-all cost of light is to remain the same.

Energy cost would have to be increased 5 per cent, or at the one cent rate, by $1.53. Nine lamps would be required instead of the 8.5, to obtain the 20,000 lumens. These would then have to be purchased for $1.53 less than the original $6.55 for the 8.5 lamps.

Net lamp cost then becomes $5.04, or 56 cents each. The discount for the inferior lamps would thus have to be 49 per cent instead of the 30 per cent assumed on the normal lamps (19 points higher). Making the same computations for a three cent rate for energy would disclose that the 9 inferior lamps would then have to be purchased for 22 cents each (discount 80 per cent) to equalize the cost of light. Were the energy rate five cents per kilowatthour, the inferior lamps would have to be free plus a bonus.

Study All Lamp Types

So it goes. Numerous lamp types are offered and the plant engineer will do well to study all from every angle before making his decision. He should then avoid increasing the number of types (including wattage ratings) unless he can assign a large area to the new type or replace other types, on account of the stock and replacement problems. In comparing costs, he should consider the savings in labor provided by installing a group replacement plan. For details regarding this, see page 90 in PLANT ENGINEERING for August, 1953.

A poorly controlled stock is often the cause of frequent small, urgent orders and continued outages while waiting for lamp deliveries. The cost of placing and servicing a large order is little more than that for a small order. Also this unit cost becomes truly exorbitant when small emergency orders are placed frequently, calling for unusually prompt service.

To demonstrate this, consider the difference between a telephoned order (confirmed in writing), with a rush delivery required of the small item, as compared with a normal written order and routine handling. Not all of the burden of rendering a good service should be placed on the supplier.

This expensive practice can be

Table shows approximate cost of developing 20,000 lumens for 7500 hours with different lamps, with energy rate at one cent and three cents per kilowatthour

LAMP TYPES	Incandescent		Fluorescent S.C.W.[1]			Mercury	
Lamp Specifications	300W	500W	40WT12	96"T12	90WT17	H400A1	H400E1
Initial Lumens[2]	5650	9900	2350	4950	4950	15000	19000
Approximate Watts, including ballasts	300	500	48	88[3]	99[4]	450	450
Efficiency, Lumens/Watt:	18.8	19.8	49	56	50	33	42
Lamp Life—Hours	1000	1000	7500	7500	7500	4000-6000	4000-5000
List Price of Lamp	$ .65	$ .95	$1.10	$3.50	$2.55	$10.50	$17.00
Net Price of Lamp[5]	$ .45	$ .66	$ .77	$2.45	$1.79	$ 7.35	$11.90
List Price of Starter	—	—	$ .72	—	$1.00	—	—
Net Cost of Starter[6]	—	—	$ .25	—	$ .35	—	—
Net Cost, Lamp and Starter	$ .45	$ .66	$1.02	$2.45	$2.14	$ 7.35	$11.90
Number of Lamps for 20,000 Lumens	3.54	2.02	8.5	4.05	4.05	1.33	1.05
Lamp Replacements in 7500 Hours	7.5	7.5	1	1	1	1.5	1.67
Total Number of Lamps Used	26.5	15.1	8.5	4.05	4.05	2	1.75
Total Cost, Lamps and Starters	$11.90	$9.95	$8.65	$9.90	$8.65	$14.70	$20.80
Total Watts	1060	1010	408	356	400	600	472
Total Kilowatthours	7950	7575	3060	2670	3000	4500	3540
Cost of Kilowatthour at 1 cent	$ 79.50	$ 75.75	$ 30.60	$26.70	$30.00	$ 45.00	$ 35.40
Total Cost, Lamps plus Energy	$ 91.40	$ 85.70	$ 39.25	$36.60	$38.65	$ 59.70	$ 56.20
Cost of Kilowatthour at 3 cents	$238.50	$227.25	$ 91.80	$80.10	$90.00	$135.00	$106.20
Total Cost, Lamps plus Energy	$250.40	$237.20	$100.45	$90.00	$98.65	$149.70	$127.00

1 Standard Cool White
2 Computations based on initial lumens—comparable lamp depreciation assumed
3 Series ballast assumed
4 Four-lamp ballast assumed
5 30 per cent discount assumed on lamps and starter
6 One starter replacement assumed for each two lamp replacements

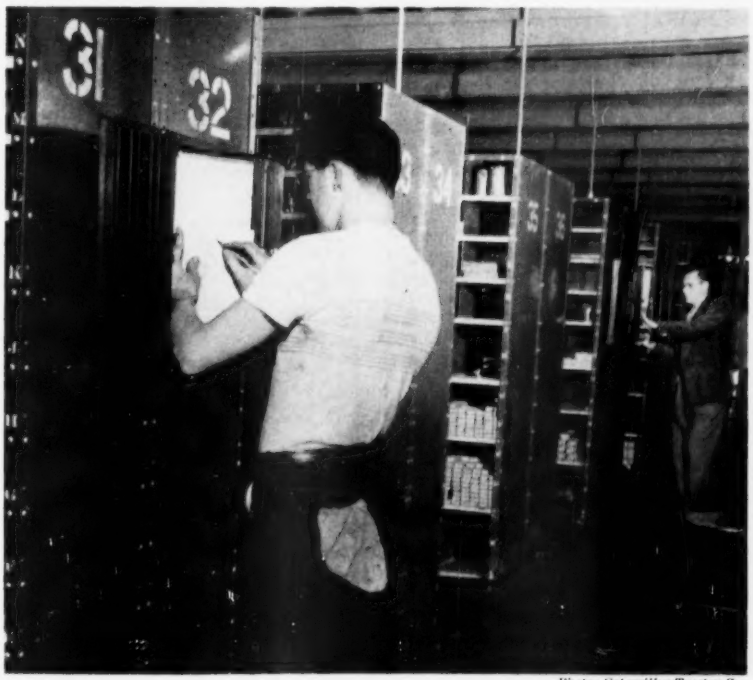


Photo: Caterpillar Tractor Co.

Carefully prepared stock control will eliminate single item order. The stock clerk should set up lighting needs with help of plant engineer and purchasing agent

avoided by a carefully prepared stock control plan, which will also produce other economies. This the stock clerk should set up, with the assistance of the plant engineer and the purchasing agent.

He should first endeavor to determine a safe, minimum stock on each item. As a rule, there is a rather definite use pattern for the various types of lamps installed. Observation will indicate this and it will form the basis of the minimum stock quantities, by types, which will almost always meet even emergency requirements.

The clerk should then decide on normal stock order quantities of these items on a similar basis. The quantities selected, incidentally, should also be such that, alone or in natural combinations, they will assure maximum discounts under the lamp contract. Frequently these two quantities (minimum stock and normal order) will be the same. The amounts of each should be posted on the stock record sheets or cards and perhaps on a bin label.

It is now suggested that each minimum quantity be set aside, perhaps by wrapping the lamps and putting them in the back of the bin. As soon as it is necessary to draw on this reserve stock, an order should be placed for the agreed order quantity. The lamps are delivered in due course, another minimum stock is placed in reserve and the process is repeated.

There would be an important variation in this procedure in case group replacement has been adopted for part or all of the plant. As the group replacement reserve (see page 90, PLANT ENGINEERING, August 1953) becomes exhausted, an order would be placed for the full requirements plus 20 per cent, for the then complete replacement plus reserve. The normal stock control plan would then apply only to the parts of the plant and offices not included under the group replacement.

It will be seen that such a stock control plan not only will result in superior service in the plant and to the purchasing office, but will have other advantages. Among these will be keeping the investment in lamps under control. Another is the reduced loss due to handling unnecessary quantities of lamps. A further benefit is the avoidance of an overstock of lamps that might become obsolete or be superseded by improved types. Not the least advantage is the assurance at all times that an adequate, but never excessive, stock is on hand.

All of the above comments apply more particularly to fluorescent than to incandescent lamps. Fluorescent lamps have properly won popular favor. This has been due to their high efficiency, to their low brightness, to their coolness and color and to their shape which has established the lighting system as a part of the architectural treatment of the interior.

But, from the procurement and stock control standpoint, fluorescent lamps are at a disadvantage. They are both more expensive and occupy more space, on the basis of equal light output and also equal watts, than do incandescent lamps. However, they have a much longer practical life which helps reduce the replacement labor and expense for an equal period of operation.

Fluorescent lamps have a further advantage in the matter of economical handling in that there are fewer types. An increase in light output per fixture is here usually accomplished by the designer by increasing the number of lamps it contains, rather than by changing the size of lamp. Many plants will find it possible to restrict the number of types of fluorescent lamps used to a very few, perhaps not over half a dozen, including those for special purposes.

This is the expensive way to change burned-out lamps. A definite lamp replacement program, rather than individual replacement, will prove beneficial

With reference to the selection of a supplier by the purchasing agent, a number of things should be considered. One of these is the brand of lamps carried and the completeness of the line from the standpoint of the plant requirements. Orders placed at higher prices outside the contract, because the types are unavailable from the normal supplier, could nullify a considerable price advantage in the contract.

Careful consideration should be given before a contract is awarded for other than superior quality lamps. As previously stated, the lamp cost is really a small part of the cost of light, the true objective of the purchase. Thus, even a slightly better efficiency or other operating advantage, could be of greater importance than a substantial saving in lamp cost.

Purchase contracts for lamps are recognized by suppliers and manufacturers as an invitation if not an obligation to follow their product into the plant and assure its superior performance. The nature and competence of this service, as offered by a supplier, should be investigated. Not only should expert advice be expected on the product itself, but this should also be expected on the applications, including lamp selection for particular operations as well as general lighting installations. Such services, secured independently of the lamp contract, might justifiably cost more than the full price of the lamps.

Finally, all suppliers and their salesmen tend to concentrate on some certain types of business. A supplier, well informed on the particular type of plant operation applying here, might as well be selected as one who has had little such experience. In other words, buying lamps is much more than these words imply and smart buyers make the most of all the incidental services and advantages that are available.

The lamp is the kernel of the entire lighting installation, which installation in turn is one of the most important productive facilities in the plant. This fact is likely to be forgotten, since lighting is so naturally and inconspicuously a part of the plant appurtenances that it is often taken for granted. But a service breakdown, such that the lighting might not be available for a few hours, is something fearful to contemplate. Therefore, it is important to see that you get the most out of your lighting at all times.

SPRINKLER VALVE STATUS Board, Cards Tell All at Norton Co.

A three-part card—one part for the insurance company notification of valve closure; part two to hang on the status board; part three to hang on the valve—promote safety and fire prevention

No. 2 VALVE OPENING NOTICE

Hang this card, this side out, in the office of the person in charge of fire protection. When valve is reopened fill out and mail this card.

Name of Plant
Address
Valve No. Controlling
which was closed on
was reopened wide on at . m.
Drain test made by
Reason for closing
Precautions taken (Please check)

- ☐ Man stationed at valve
- ☐ Public fire department notified
- ☐ Watchman patrolling affected areas
- ☐ Plugs on hand for closing open pipes
- ☐ Fire hose laid from hydrant

Signed

If valve is opened almost immediately after closing, this card alone is sufficient to notify insurance company.

SPRINKLER VALVE CLOSED

ATTACH THIS TAG TO VALVE. DO NOT REMOVE UNTIL VALVE IS REOPENED

Valve No.
Controlling
Closed on at . m.
By
To be closed only until at . m.
Reason for closing
Closing authorized by
Opened on at . m.
By
After opening valve return this tag to
In Charge of Fire Protection

Save this tag until next insurance inspector visits plant.

No. 1 VALVE CLOSING NOTICE

Mail this card to reach insurance company 24 hours before closing valve if possible. Telegraph in emergency.

Name of Plant
Address
Valve No. Controlling
Closed on at . m.
Will be reopened on
Reason for closing
Precautions to be taken (please check)

- ☐ Man stationed at valve
- ☐ Public fire department notified
- ☐ Watchman patrolling affected areas
- ☐ Plugs on hand for closing open pipes
- ☐ Fire hose laid from hydrant

Signed
Title

IF VALVE HAS BEEN OPENED USE CARD NO. 2

Above: A. A. Mullen, Pipefitter, hangs valve-closure notice on status board as he goes out on sprinkler repair job. Left: One side of the three-part card

BY MEANS OF a valve status board, maintenance men at Norton Company, Worcester, Mass., can tell at a glance the condition of any sprinkler protection shut-off valve in the entire plant.

Key to the successful operation of this control system is a three-part card provided by Associated Factory Mutual Fire Insurance Companies. Part one is a form on the reverse of a business reply post-card used to notify the insurance company of sprinkler valve closure 24 hours in advance (if possible). Part two is a valve opening notice which is hung on the status board while the valve is open.

When work is completed, the tag is removed, closure time and date indicated, and the tag mailed to the insurance company. Part two is also on the reverse of a post card. The third part of the card is a tag which is tied to the sprinkler shut-off valve while work is in progress. After work is completed, this tag is retained by the maintenance department until the next visit of the insurance inspector as a record of the valve closure.

Three Operations

In practice, the first part is mailed to the insurance company before work is to be done (except in emergencies). The remaining parts of the card are issued to the man doing the work along with his work order. He hangs part two on the status board and ties the third part on the valve which is closed. When these papers are issued to the man doing the work, the Norton Fire Department is notified by telephone that the valve is to be closed and they in turn notify the A.D.T. system to disregard any warning signal resulting from that particular valve. When the papers are returned to the maintenance supervisor after the completion of work, the fire department and A.D.T. are again notified.

In the event of emergencies in which the valve is opened immediately after the closure, only part two is sent to the insurance company.

While this system is not unique with Norton Company, the status board itself is a type not widely seen in plants. The chance of leaving a valve closed unknowingly is practically eliminated since a red tag is plainly visible as long as the valve remains closed.

Thus, there is a constant, plainly-visible reminder as to the position of the valve.

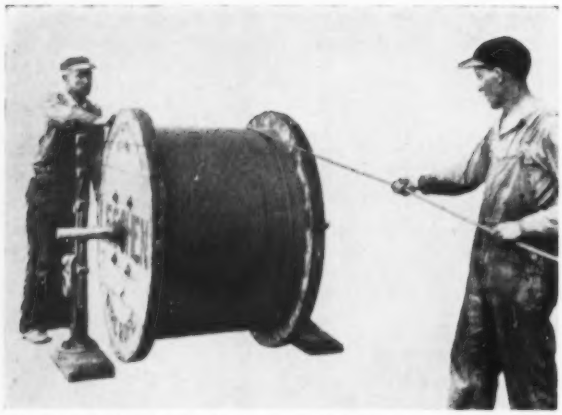


Fig. 1. Illustrating right way to take wire rope from a reel

Fig. 2. Illustrating wrong way to take wire rope from a reel

Correct Care and Handling of WIRE ROPE

Wire rope is only as strong as its weakest point . . . Don't create these weak points by careless or ignorant handling . . . Here are a few important points to keep in mind

By **WALTER C. RICHARDS**, Chief Engineer, **A. Leschen & Sons Rope Co.**

CORRECT handling of wire rope before use is essential if best results in its use are to be obtained. Wire rope is often referred to as a machine and should be handled accordingly.

Wire rope arrives on the job either in a coil, or wound on a reel. It will no doubt reach its destination in a railroad car or truck. When unloading do not drop the reel onto the ground or platform. The heavy rope might shift its position or from its inertia alone cause the reel to collapse. The collapse, alone, might damage the rope, or it would be damaged in the difficult operation of removal from a collapsed reel.

If it is in a coil the rope might be bent enough to give it a permanent set. Do not roll reels or coils over very stony ground. The weight may cause sharp rocks to indent the rope. A bar used to roll a reel will do the same thing if it bears against the rope. Instead use the bar against the flange.

Storing . . . Reels and coils are generally stored for a period before installation. They should be placed under cover if possible or at least kept clean and dry and protected from the weather. Do not keep rope in a place that can be reached by acid fumes or other corrosive agents.

If the rope is to remain in storage for some time, it is advisable to cover it with waterproof paper. As received, it is frequently factory covered with a "protector" which will preserve it for a long time. Otherwise, the outer layer should be covered with a rope lubricant.

If used rope is put into storage, the same precautions should be taken to protect it from corrosion. In addition it should be thoroughly cleaned and given a coating of lubricant. It should be wound on a reel and not coiled loosely on the ground or floor. Do not pile heavy pieces of equipment on top of the rope.

Great care should be taken in handling and installing wire rope.

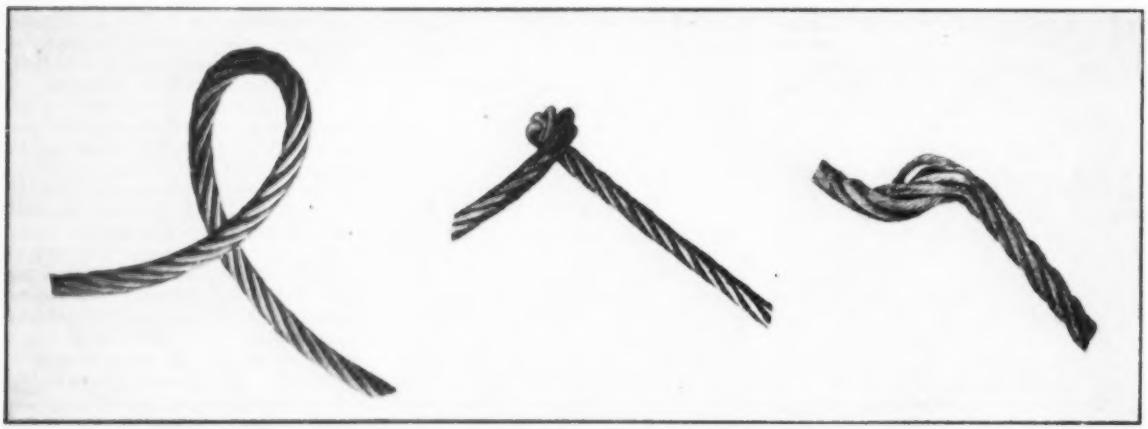


Fig. 3. A kink starts when the rope starts looping like this . . . and the damage is done when the looping tightens as shown. Even if the wires are not badly damaged, the rope is out of shape, which means excess wear on the displaced strands. If the loop is thrown out at the start, kinks can be avoided. Wire rope is an expensive item—treat it kindly

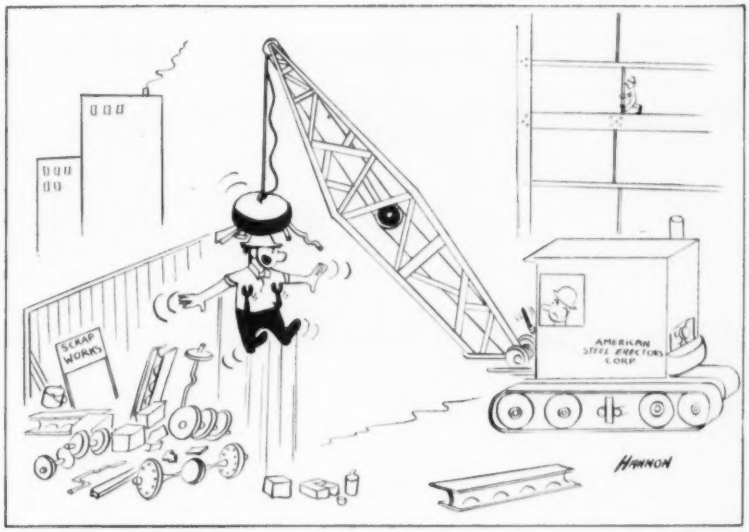
Otherwise it may become permanently damaged before it is put into service.

Kinks and kinking . . . Careful handling will prevent kinks, which are almost impossible to remove and result in permanent damage to the rope. If a loop forms in slack rope, it should be thrown out at once, because a kink will develop if this loop is drawn tight. The strands are distorted and become permanently set in this position. Excess wear occurs and wires will fracture at this point. Even if the wires are not badly damaged, the rope is out of shape, which will mean excess wear on the displaced strands.

Unreeling and uncoiling . . . There is always danger of kinking a wire rope if it is improperly unreeled or uncoiled. A reel should be mounted on jacks or a turntable so it will revolve as the rope is pulled off. Sufficient tension should be applied to keep slack from accumulating, by means of a board acting as a brake against the reel flange. Or, the end of the rope may be held by a workman and the reel rolled along the ground.

When transferring rope from one reel to another be sure the rope is taken fom the top of the full reel and wound over the top of the empty reel, or from the bottom of one reel to the underside of the second reel. Reverse bends are thus avoided.

Inspection of equipment . . . Before installation, the drums and sheaves on which the rope is to be used should be carefully examined. A new rope cannot be expected to give good service if the sheaves or drum are badly worn or damaged. If a sheave is out of round or has worn bearings, it will not run true and will damage the rope. Make sure the grooves are smooth and of full diameter. A sheave with a corrugated or pinching groove should be turned out or replaced.



Installing . . . It is good practice to wind the rope directly from the reel to the drum, being careful to see that the bends are made in the same direction as when transferring rope from one reel to another. Mount the reel with the axle parallel to the drum and keep it under tension to avoid accumulation of slack. On a smooth-faced drum a little more tension should be applied and the wraps kept close together without crowding. A right-lay rope spools best if wound from left to right over the top of the drum when viewed from the side opposite to that from which the rope is leading onto the drum. If underwound, the rope should lead from right to left.

Breaking in . . . It is very important, when starting to operate a moving rope, that the machine should be run for a while with no lead, and for another period with a light lead to enable the wires and strands to adjust themselves. By doing this, the rope will have "set" itself to the working conditions and when full operation is reached, it will operate more safely and efficiently. The time spent in breaking in a wire rope will be more than regained by the extra service that will be obtained.

Working load . . . The ratio of the rated breaking strength to the normal working load is called the safety or design factor. In selecting the proper rope to use on any installation, it is necessary to employ an appropriate design factor. The estimated design factor should be greater if a careful calculation of all the forces acting upon the rope is not made.

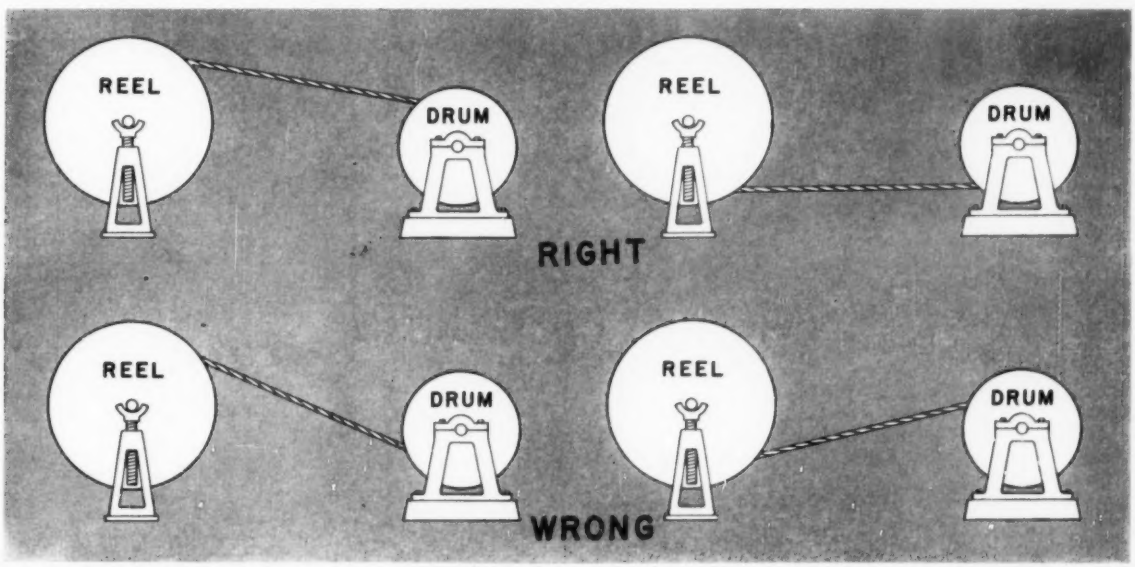


Fig. 4. Right and wrong ways to transfer wire rope from a reel to a drum to avoid kinking and weakening of rope

Safe Operating Practices Mean More Industrial Truck Service

More value from your industrial truck investment is possible through proper selection and training of operators plus a maintenance program . . . Author also lists operating tips for getting the most out of industrial trucks

By **FRED W. BRAUN**, Vice President, Accident Prevention, Employers Mutuals of Wausau

HANDLING OF MATERIALS is a major source of accidents. Almost half a million people are injured every year while engaged in moving materials, articles and equipment from one place to another.

There has been constant improvement in methods for mechanical handling of materials through the use of industrial power trucks. Much of the savings this equipment promises, however, can be dissipated through improper operation and maintenance.

Plants which are most successful in the safe use of power truck equipment are those which have recognized the inherent hazards involved and have taken constructive steps in driver selection, training and truck maintenance.

Such a program is of inestimable value in the operation of shop jeeps, tractors, high and low fork lift trucks, transporters and every kind of industrial power truck not normally used on public highways.

To obtain good power truck drivers it is necessary to know the requirements of the job. Many accidents will be prevented if drivers have the necessary physical qualifications. Each prospective driver, therefore, should have a thorough pre-employment physical examination. Special attention should be given to the heart, blood pressure, varicosities, hearing and vision. It is also advisable to set up a pattern interview that will help the personnel department in the selection of capable power truck drivers.

Appointment of a competent trainer is the first and most important step in the proper instruction of power truck operators. He should be a reliable, experienced man—thoroughly familiar with all types of shop equipment and materials which are handled in the plant. He should know the routes to be travelled and the troublesome areas.

The trainer will instruct the new driver on all the uses of the truck, its controls and various phases of operation. He will demonstrate these functions through actual operation. At the end of the instruction period, the prospective driver should demonstrate to the trainer his ability to operate the vehicle safely under simulated shop conditions. Various types of suggested obstacle courses are suggested for this purpose.

When the driver is approved by the trainer, it is usually well to assign the new driver to the handling of raw materials in the least hazardous areas of the plant. Then when he has proved his ability as an operator, he can be assigned where needed.

In the course of his normal duties, the trainer should keep an eye on all power truck operators in action and provide any retraining or correction that is necessary. He should get reports on any unsafe acts, such as speeding or recklessness, and should investigate each case so that corrective measures may be taken.

Before the new driver goes on regular duty, the trainer should impress him with the importance of reporting any defects of his truck immediately. The best of shop trucks may break down from constant use or become unsafe to operate.

Fig. 1. Operator training is the first and most important step in safe industrial truck operation. Each driver should be familiar with operations of all trucks

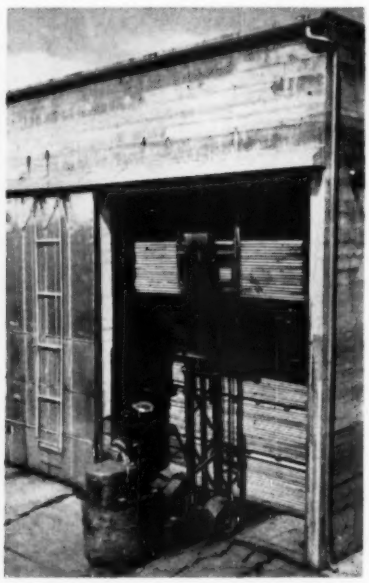
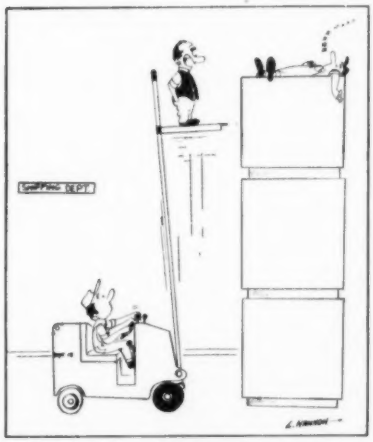


Fig. 2. Be sure that you have the right industrial truck for the job at hand

Shop trucks are usually serviced at the garage or some central point in the plant. There they are greased, oil changed and, in the case of electric units, batteries are checked and recharged.

Such servicing should always include an inspection of the points which involve safe operation. These are the controls, brakes, wheels, steering gear, warning devices and lights. Proper engine performance should be maintained to insure efficient combustion and avoid carbon monoxide hazard. Batteries of electric units should be checked for proper ventilation. A possible explosion can be caused by hydrogen gas forming in enclosed battery cases. Location and replacement of non-arcing switches are important on electric trucks.

All these items and possibly others should be inspected at least once a month. An inspection report should be made to record unsafe conditions found and the corrections made. Maintenance men should be familiar



"Well, good afternoon, Fleming . . . FLEMING!"

with instruction booklets issued by the manufacturers of the power trucks they service.

Hand trucks and wheelbarrows of various types are used in practically every industry. Many accidents arise from (1) use of the wrong type of truck or wheelbarrow to handle the materials being moved, (2) use of equipment of weak construction or in poor repair, (3) poor floor conditions or insufficient aisle space, and (4) careless loading or unloading practices.

In this article we have described a few of the more important hazards in the safe operation of industrial power and hand trucks. The more shop truckers know their job, take pride in it and do it in safe, expert fashion, the more value a company gets from its investment in this equipment. Trucks not handled in this way can bring on an acute case of the very ailments they were intended to remedy—muscle-strain, grief and pain.

TIPS ON INDUSTRIAL TRUCKS

1. Try your brakes and controls at the start of every shift.
2. Don't operate a truck when your hands are wet or greasy.
3. Brake with the brake, not the reverse controls.
4. Never shift the transmission while truck is moving in opposite direction.
5. Plan your load. Put the heavy part low, the light part on top. Keep load balanced so nothing is likely to shift or fall.
6. Be sure you have the right truck for the job at hand.
7. Keep load below eye level. You must always have a clear view ahead. Sometimes this means traveling with the load behind the unit.
8. In using a lift truck, never carry a load in an elevated position. Be sure both forks are under the load before lifting. Always tilt the load toward the unit before transporting it.
9. Use warning signals only when necessary—then be sure they're heard. Several short signals are better than one long one.
10. Slow down when approaching danger spots such as curves, blind corners, ramps, railroad tracks, wet or oily floors.
11. Watch your clearances. Don't cut corners. Use special care in backing. Keep a safe distance from other trucks or pedestrians.
12. Never push another truck or piece of freight with the ends of the forks.
13. Approach elevators at right angles. Come to a full stop before entering. Be sure total weight of truck and load is within elevator capacity. Turn off engine while on elevator. Dismount and make certain your truck cannot move.
14. Park truck only in safe areas; never in main aisles, on railroad tracks or in any unauthorized areas. In parking truck, leave it out of gear and with controllers disengaged.
15. Gasoline-powered trucks should have a screen over the exhaust pipe. Check this regularly. Kill the motor before you gas up. See that you have plenty of ventilation when operating a gas truck in a confined area.
16. Kill motor to avoid unnecessary idling that will produce fumes.

TIPS ON OPERATING HAND TRUCKS AND WHEELBARROWS

1. Use the correct type of truck for the job. Limit the load to the worker's safe capacity.
2. Load material carefully so that it will not slide or fall off.
3. Ask for help if the load is too heavy. Don't strain yourself.
4. Be sure truck is in good condition. Do not use a truck with broken wheels or damaged handles.
5. Don't make your own repairs. You may be the one to scrape your ankle against the cotter pin you replace with a nail.
6. Give ample warning when you approach blind corners.
7. When trucking in close quarters keep close watch to avoid scraping your knuckles.
8. Wear safety shoes. Avoid horseplay.

Four-wheel push trucks

1. Get the habit of keeping your feet out from under wheels and casters while loading and shifting position of truck.
2. Never load a truck so high you can't look over it to see where you are pushing it.
3. Keep your hands where fingers will not be crushed if truck bumps into a stationary object.
4. When truck is not in use, the handle should be kept in upright position to avoid a tripping or stumbling hazard.

Two-wheel hand trucks

1. Balance the load so that it will stay put on the truck. If load is not balanced over wheels, danger of muscle strain is increased.
2. Never go ahead of your truck down a ramp.
3. Never run a truck over a plate or skid that is not securely fastened.
4. Never leave a truck where it can fall over and obstruct a passageway.

Safe wheelbarrow operation

1. When wheeling a heavy load, keep your back upright and lift with your legs to avoid back strain.
2. Balance all heavy loads and they will be less likely to throw you.
3. Stay clear of handles when handling heavy loads.
4. See that all wheeling planks are well supported and not apt to shift out of place.

Tips on Castings Specifications —One or a Thousand

Whether you're a plant engineer who may buy just a few castings for replacement purposes or one who may specify thousands, here are some tips from an experienced buyer which will be of help in placing your next order

By DONALD N. GENT, Wellsville Works, Worthington Corporation

CASTINGS OF IRON, bronze, steel, stainless, and malleable, in most heavy machinery plants constitute one of the largest single items of raw material. Some plants operate their own foundries, but even in these, many castings must be purchased from outside vendors, making the intelligent procurement of castings of prime importance.

One of the oil companies, in its advertising, uses the phrase "The Economy of Quality." There is no place where this phrase is more applicable than in castings.

How, then, shall we go about getting this "economy of quality?"

In issuing an inquiry or purchase order for any casting, particularly a new design, the following information should be given to the vendor.

1. Kind of metal, including chemical and physical specifications, or ASTM or the user's specification number.

2. Detailed drawing showing actual or estimated weight of the casting, important dimensions, dimension tolerances and machined surfaces with amount of finish to be allowed, and specific location for pattern numbers and symbol numbers, and whether raised or sunken letters are preferred.

3. Quantity required with delivery dates and schedules.

4. Description of available pattern equipment and its condition, indicating—

a. Type of pattern, loose, gated, matchplate or cope and drag plate with number of patterns; if loose whether suitable for mounting, and size of plates.

b. Material from which pattern is constructed, hard or soft wood, brass, aluminum, or plastic.

c. Number of cores per casting with kind and type of core boxes including the number of cores to each box, material from which corebox is made, whether designed for core blowing machines, and number and kind of core dryers.

5. If no pattern equipment is available, foundry should be given the opportunity to suggest how pattern should be made.

6. Description of the service or use of the casting. If the castings are to be subject to pressure, give the test pressure and method of making the test. Also specify if test bars or inspection will be required and by whom inspection or test will be made.

7. Indicate any special crating, marking or packaging and whether or not partial shipments will be accepted.

Experience shows that many casting troubles result in buying castings from a foundry which simply is not qualified to do a particular job. While there are some foundries which can successfully produce all types of castings, they are in the minority. For example, obviously a foundry which produces a casting such as thin furnace castings or finned air compressor cylinders exclusively (using a very hot sharp iron) is going to have trouble with porosity and shrinkage on a heavy section casting even if it is in their size range.

A visit to a proposed foundry source to inspect facilities and to see the type of work produced is a great aid in selecting the proper supplier.

Pattern Equipment

One of the most important things in the effective purchasing of castings is proper pattern equipment. The foundry should be given the opportunity to suggest how a pattern should be made, but these suggestions should be analyzed thoroughly. If the pattern is going to be subject to extensive alterations in the future, it should be built with this in mind, even though the foundry might not be as completely happy with it if it were built exactly to their specifications.

Naturally, every foundry would like to have the finest possible pattern equipment for every job; however many plants use some designs only one time, so the pattern must be built as economically as possible. In many cases, designs which originally were thought to be special have become standard. A good practice for all of this type of pattern is to make them suitable for mounting if possible.

Since the cost of the lumber is only a slight part of the pattern cost, small patterns should be made entirely of hard wood and large patterns should be faced with hard wood on the wearing surfaces. If these special designs then become standard, a new pattern does not have to be built unless the quantities justify a matchplate or cope and drag pattern.

If quantities increase to a point where several hundred castings are purchased at a time, and here is where buying record cards are valuable, consideration should be given to mounted aluminum matchplate or cope and drag plate patterns. In many cases, the cost of these patterns can be absorbed by savings in cost in a relatively short time. Here again the foundry should be consulted before making or buying the pattern. However, insist on using standard size plates, in case the patterns are moved in the future.

In buying metal matchplate and cope and drag patterns—and this is very important—insist on separate patterns mounted on the plate. Metal patterns which are cast integral with the plate cannot be removed to change the plate size or moved to change the gating.

It is a good idea to take your pattern superintendent or foreman with you or your buyer when inspecting foundry sources.

Many manufacturers are faced with the problem of using some antiquated pattern equipment. Every buyer of castings has heard the old saying "We're never going to use it again so see if you can't get one more casting from it." The purchasing agent has a job to do to sell management on the importance of proper pattern equipment, since with the ever increasing shortage of skilled molders, more and more of the foundry work must be done in the pattern shop.

Close cooperation between the pattern shop and the purchasing department is most essential to effective casting procurement.

In all fairness to the foundries, it must be admitted that many casting troubles could be eliminated by proper casting design. It would be of great help if it were possible for every engineer and draftsman to spend a month or two working in a foundry, to be acquainted with the problems that improper designs create.

In most cases the foundries which enjoy the best reputation for quality are those which study the designs and suggest changes in order to get sound castings. This practice should definitely be encouraged, for only in this way will the Engineering Department realize that many casting defects are born on the drafting board.

(Continued on page 144)

POWER CHUCKING EQUIPMENT— Air-Hydraulic Systems in Action

By H. L. STEWART, Special Engineering, Logansport Machine Co., Inc., Logansport, Indiana

IN PEACE TIME or war time power chucking has broken many production bottlenecks in mass-producing precision parts on lathes, grinders, boring machines, winding machines, and on other metal working machines. As the labor and material market becomes more acute, management must seek better ways and means of keeping production at its maximum and losses from scrap at a minimum. The production and planning departments have given management the answer to their problem by equipping their high production turning machines with power operated chucking equipment.

There are two classifications of power chucks: (1) chucks operated by a power chuck wrench, and (2) chucks operated by a power operated drawbar. Since this series of articles dwells on fluid power, we will only consider the second which is more widely used on mass production.

Power chucking equipment consists basically of a chucking device; a chuck adapter, if the spindle nose of the machine is not of the American standard type; a rotating cylinder; a rotating cylinder adapter; a draw rod to connect the rotating cylinder to the chucking device; a four-way control valve to operate the cylinder; and a regulator, filter, and lubricator unit (if air is the operating medium) to process the air properly.

Older type lathes do not have American standard type spindle noses and the adapters designed for these machines have an American standard fitting on one side and a fitting for the spindle nose on the other. These adapters should be as thin and light as possible so as to eliminate excessive overhang and weight on the spindle.

Chucking devices may be of many different designs. They may, however, fall under four classifications: a chuck, a collet, a mandrel, or a special fixture. Power chucks which are listed as standard by various manufacturers are of the universal, combination and serrated jaw types in two and three jaw models. There are many special designs available such as the finger type chuck which has proved valuable in the jet engine program, and the indexing type chuck for holding complicated fittings. The indexing chuck is quite complicated in design and expensive to build.

Collets and Mandrels

Power operated collets and mandrels have been the answer to the artillery shell program. Without them production would be much slower. There are, however, many peace time uses for these holding devices such as on tubes, gear blanks, bar stock and discs.

On artillery shells power operated mandrels are classed as centering type, rough turn and finish turn type. Mandrels are used for heavy stock removal operation. The centering mandrel holds the shell for the first machining operation which is to machine a center in the end of the shell, and cut off the open end. This mandrel has six jaws, three equally spaced at two locations.

All centering mandrels are designed with adjustable work locators with hardened noses for properly locating the shell with regard to the machine tooling. While some centering mandrels are built with work locators as part of the mandrel, others have the work locator as a separate loose fixture which is dropped into the shell before it is placed on the mandrel. Once the locator is properly set, the whole production run is usually machined without resetting.

Rough turn power mandrels are designed with three serrated jaws—getting the maximum gripping pressure for the very heavy metal removing operation. The jaws must dig into the forging sufficiently so there is no possibility of slippage. If the shell should start to slip during the operation, it will burn the teeth off of the serrated jaws.

Rough turn mandrels are usually of the pull type construction, pulling against a very shallow angle to give high gripping force. Stock removal up to $\frac{1}{8}$ in. is performed by the use of cemented carbide cutting tools. A 76 mm shell can be machined on rough turn operation with multiple tools in about 45 seconds.

For support on end of shell, a tail stock center is used. On thin walled shells the holding problem is much more difficult. The shell must be held tight enough so that it will not

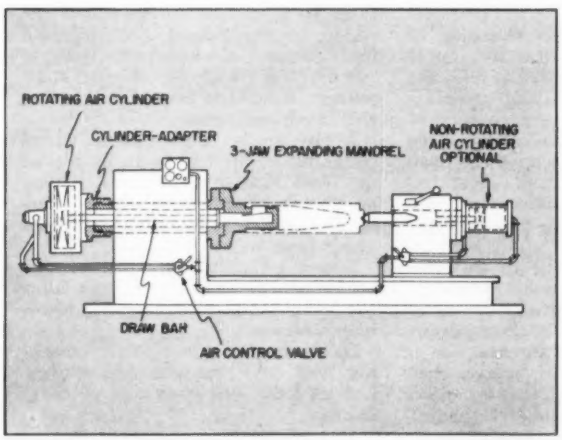


Fig. 1. Air operated chucking equipment is equipped with three-jaw expanding mandrel, adapter and pneumatic cylinder

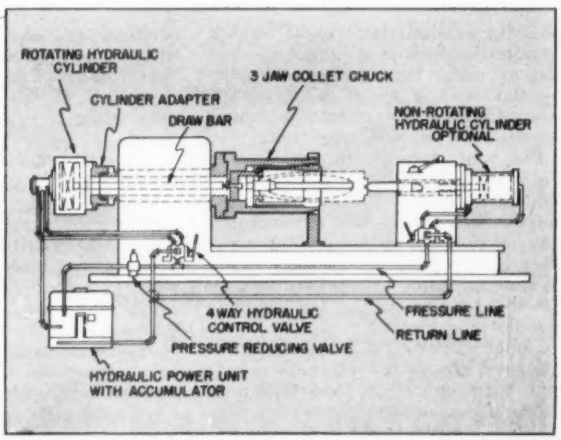


Fig. 2. Hydraulic operated chucking equipment is equipped with three-jaw collet chuck, four-way hydraulic control valve

slip—yet it must not be distorted. The use of wrap-around type jaws usually solves this problem.

Finished turn mandrels have three jaws which grip in the fuze recess of the shell. These mandrels perform the finish taper turn, the finish turn, and the finish form turn operations. On shells with small fuze recesses it is sometimes difficult to design enough strength at the gripping point to perform the operation. A push type mandrel is usually used in these instances.

Power operated collet chucks are used in most cases for the final machining operations on the shell. They are used for the nose operation and for the bore operation. In large shell work collet chucks become quite bulky since the gripping must be done near the center of the shell. It is usually necessary to build a steady-rest on the end of the collet body to relieve the weight on the spindle bearings of the machine, and also to relieve the side thrust created by the cutting tools. Most of the steady-rests have needle or roller bearings for smooth operation.

For operations on the nose end of the shell, it is located in the collet against a hardened female work locator which is attached to the collet body through a spider arrangement. This locator can be changed easily so that the same chuck can be used for the bore operation by inserting a male type locator.

Collet chucks hold the shell for the band groove operation, face base and turn operation, and the nose threading operation. On many production shell lines the threading operation is done on tapping machines especially designed for this purpose. Universal type chucks have been used successfully for several different operations on the very large shells.

The rotating cylinder may be air or hydraulically operated. When operated by air, the source of power is from the air compressor, but if hydraulically operated, the source of power will be from a small hydraulic power unit of the accumulator type or the continuous operation type, the first being the most satisfactory on most lathe installations.

Rotating cylinders are designed with closed distributor shafts for high speeds or hollow distributor shafts for barstock or coolants. Rotating air cylinders with closed distributor shafts are now designed for operations up to 3000 to 4000 rpm for continuous duty operation.

On cylinders with hollow distributor shafts there is always a packing problem involved. As the size of the hole increases in the distributor shaft, the more this problem becomes apparent. If the rotating speed is very high, it is often necessary to design a water jacket around the packing in order to keep them from burning up or charring. Most rotating hydraulic cylinders are designed with a metal to metal fit between the distributor shaft and the distributor housing. With this design the cylinders can be rotated at fairly fast speeds without creating undue heat. The oil in the hydraulic system acts as a lubricant.

In regard to control valves, they may be hand operated, foot operated, or electrically operated depending upon application.

While the components just covered are only the basic items which make up a set of power chucking equipment, many builders of production machines use power chucking equipment extensively. Some special lathes have two complete sets of chucking equipment, one for the headstock and one for the tailstock. Still other machines are designed with a basic set of chucking equipment on an air, air-hydraulic, or hydraulic feeding mechanism. Many combinations have been worked out to eliminate operator guesswork and permit one operator to tend two or more machines without undue fatigue.

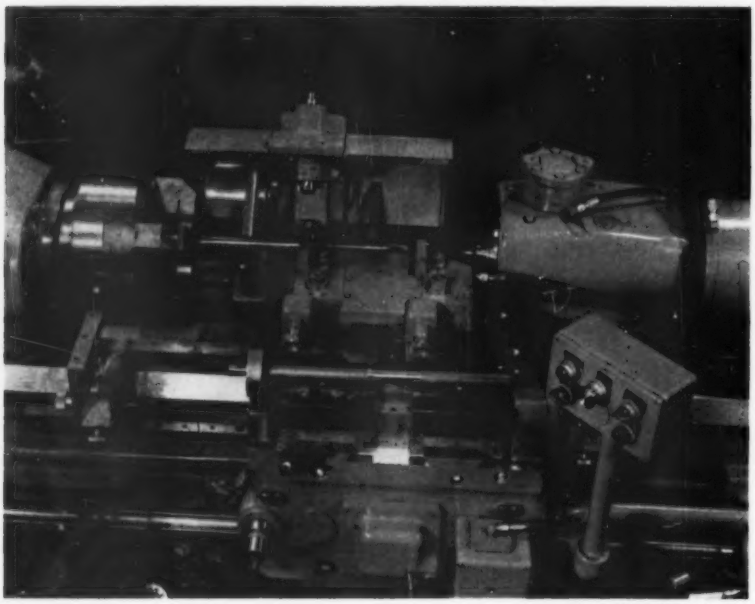


Photo: Monarch Machine Co.

Fig. 3. This machine is equipped with a three-jaw power chuck. Power chucking offers industry increase in production, reduction in scrap and lower maintenance

Air or Hydraulic?

When purchasing power chucking equipment the question often arises "Is it best to use air or hydraulics for the motivating means?" Although air is more commonly used on power chucking equipment, hydraulics have been called upon in more recent years to solve many difficult problems. Several factors should be taken into consideration:

1. The most important is the weight of the chucking equipment on the spindle. Since carbide, tungsten, and other high speed cutting tools are now being used, high gripping pressure must be applied to the workpiece. This requires a large air cylinder at normal operating pressures of 80 to 100 psi, or a small hydraulic cylinder at higher pressure. The small hydraulic cylinder can employ the same drawbar pull as the large air cylinder and the weight will be reduced substantially.

As an example, a 16-in. air cylinder operating at 80 psi impacts a drawbar thrust of 1,600 lb; whereas an 8-in. hydraulic cylinder operating at 350 psi impacts a drawbar thrust of 18,000 psi. The 16 in. cylinder weighs 170 lb and the 8 in. cylinder weighs only 100 lb. Of course, the cylinder adapter for the small cylinder will be considerably lighter than the one for the large cylinder.

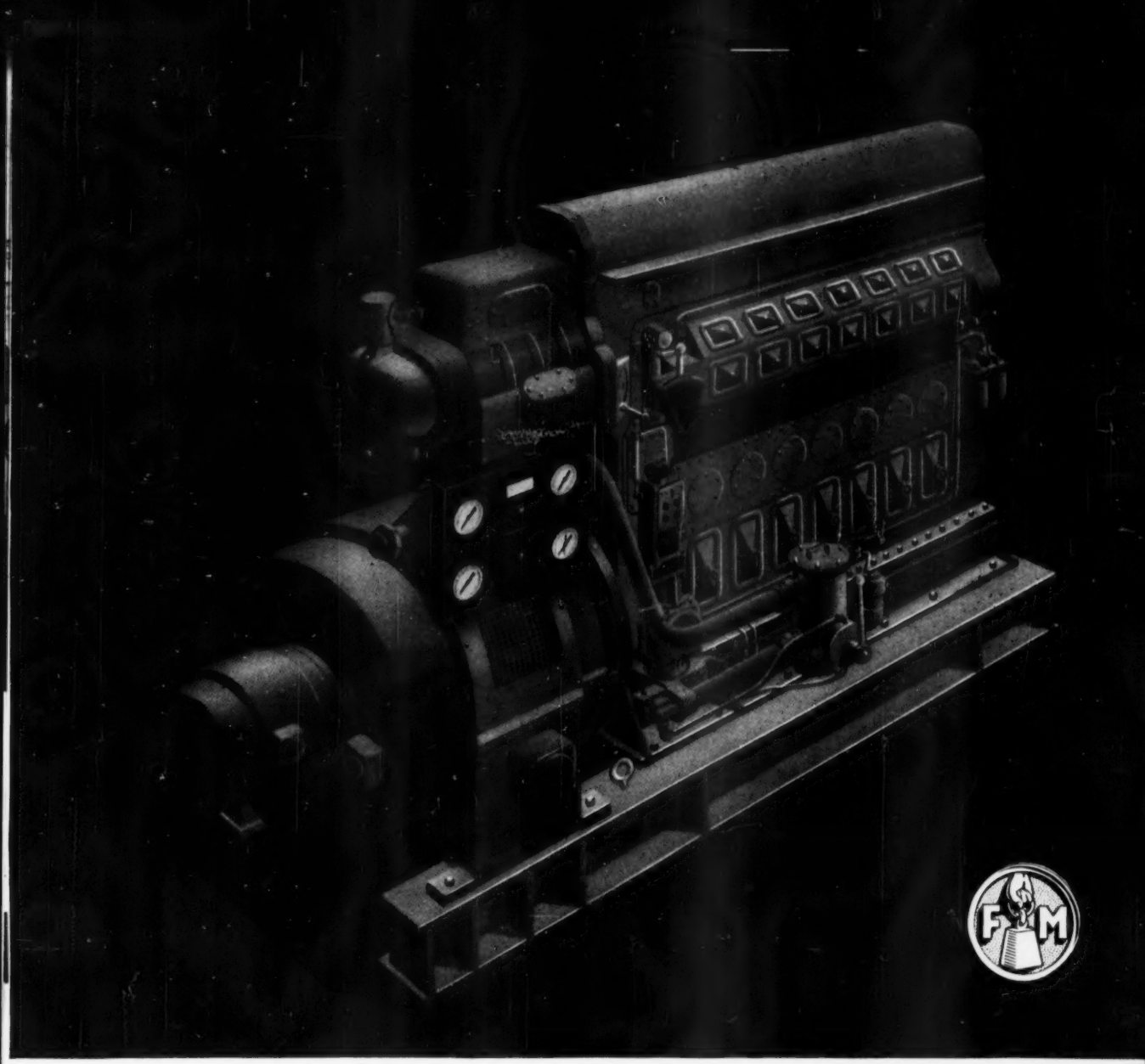
2. When a plant purchases a quantity of new power chucking equipment, it is usually more economical to go to hydraulic equipment if the added air equipment will overload their present compressors. Using a power unit with an accumulator, several machines may be supplied with hydraulic power.

3. In some large plants where chucking equipment is to be placed far from available air lines, it may be more economical to use hydraulic power than to install long lengths of air lines to one machine.

Power chucking offers three advantages: (1) Increase in production, (2) reduction in scrap, and (3) lower maintenance.

In the final analysis power chucking will save considerable money. Let us look into each one of these items.

One of the leading manufacturers of precision lathes made a comparison between manual chucking, using



The Fairbanks-Morse Opposed Piston Diesel Model 38F 5¼. 225 to 750 horsepower. Diesel, Dual Fuel and Spark-ignition options. Other O-P engines available in horsepower ratings to 2400.

Some engines are not good enough

Yes, there are some diesels which just do not have what it takes for the job. They cannot satisfy the owner's pride in smooth, trouble-free operation and are lacking in the ability to square a balance sheet of operational costs and profits. For the more difficult jobs, many engines are simply not good enough.

Maybe you should pay more and get more!

If you want more engine-hours with fewer man-hours, *then* you should have the F-M Opposed Piston Diesel which will cost a little more and give you much, *much* more.

Fairbanks, Morse & Co., Chicago 5, Illinois.

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a chuck wrench and air equipment for the chucking means. He chose pieces that were round and light enough to be lifted into the chucks by hand. Table I shows the results of this test:

Table I. Comparison between manual chucking and the use of air equipment

Chuck Size (in inches)	Chucking Time (in Minutes) Manual	Air
6	0.25	0.05
8	0.35	0.10
10	0.45	0.10
12	0.5	0.10
15	0.8	0.2
18	0.8	0.2

This would give a savings up to 80 per cent and it does not take into consideration operator fatigue. In conducting time studies on like machines doing the same work with one machine having manual chucking equipment and the other air or hydraulically operated chucking equipment, it showed that the operators using the power chucking equipment showed much less operator fatigue.

By using air or hydraulic chucking devices, a flick of the wrist or movement of the foot will immediately give full chucking power. Foot controls are usually installed where the operator needs both hands free for loading purposes.

Various Shaped Work Pieces

Another lathe manufacturer made a comparison between the two methods of chucking by selecting various shaped workpieces. He used crankshafts, drive pinions, steering knuckles, and other difficult pieces to hold. Table II gives these results:

Table II. Comparison of manual and air chucking with various work-pieces

Item	Chucking Time (in Minutes) Manual	Air	Time Saved Per cent
1	0.35	0.14	60.0
2	0.40	0.20	50.0
3	0.43	0.16	63.0
4	0.35	0.12	65.7
5	0.38	0.12	68.5

The over-all time saved averaged a little over 60 per cent which means many dollars saved on long production runs.

There are several ways of reducing scrap when using power operated chucking equipment.

1. Gripping pressure is always the same. The amount of pressure applied is not left up to the strength of some strong arm operator, but is always the same for each pressure setting of the relief valve. When finishing thin walled tube parts or other thin walled parts, if the operator applies too much torque on chuck wrench with a manually operated chuck, the work pieces may be distorted and scrapped. When using power chucking equipment, by merely adjusting the relief valve on the original set-up, the pressure remains the same.

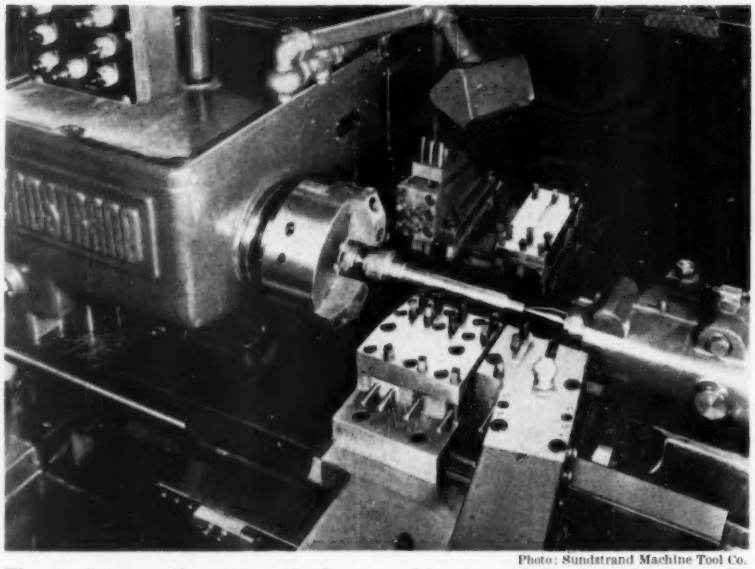


Photo: Sundstrand Machine Tool Co.

Fig. 4. Compensating power chuck on machine is used for long forgings. On heavy forgings, few straight serrations on jaws are better than many serrations

An instance where power chucking has greatly reduced scrap losses is on workpieces which start out with a very heavy section and must be gripped accordingly. When the large amount of stock is removed the gripping pressure must be substantially reduced for the finishing operation. This can be done by merely shifting a valve handle which changes the gripping pressure from high to low.

2. Reserve movement of jaws is always present when needed. When a hand operated chuck is used, after the spindle starts to move, there is no chance to move the jaws until the spindle is stopped. When chucking on rough forgings and castings in which one jaw may be gripping against a sprue or an imperfection, if slippage should occur when the tool bites into the work, the power chuck jaws will keep moving in to grip the work. However, with a hand chuck there is no reserve movement.

3. On many workpieces which must be held on both a thin and thick section, power chucks with tandem cylinders have greatly reduced scrap losses. Two jaws of the chuck are operated by one section of the tandem cylinder and imparts low pressure gripping to the light section. The other two chuck jaws are operated by the other section for the tandem cylinder and imparts high pressure gripping to the heavy section.

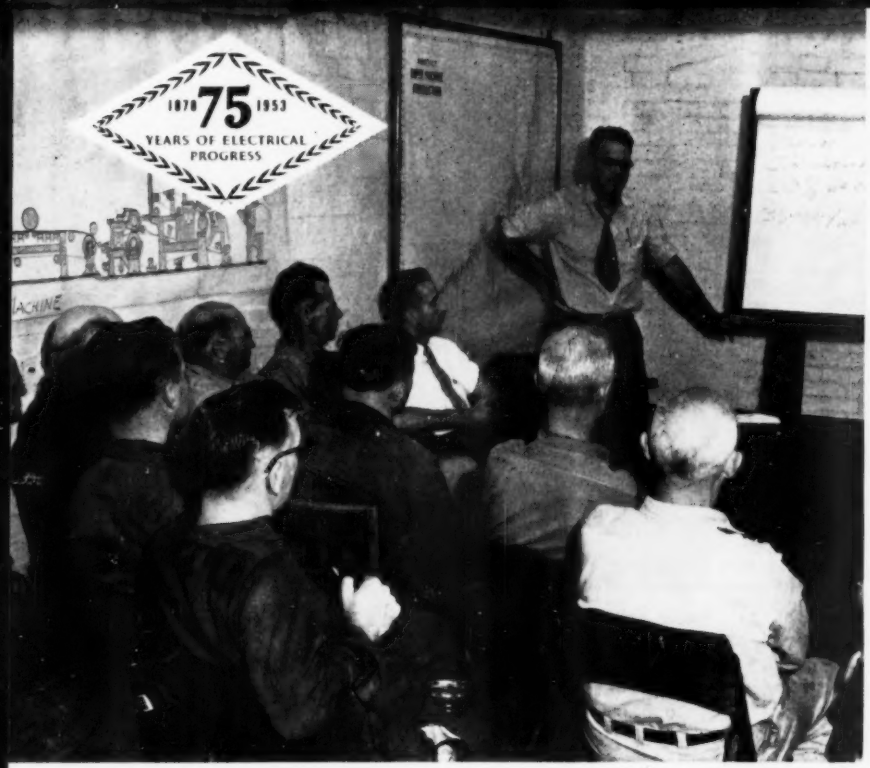
4. Since the trend is toward maximum chip removal, power chucking equipment gives the high gripping pressure that is necessary to hold the workpiece properly. Table III shows the theoretical clamping forces that can be obtained.

Fluid power chucking equipment will give many years of satisfactory service with very little maintenance. Of course there will be times when the packings in the valves and cylinders will need to be changed but these packings are low in cost. The chucks themselves should be cleaned and lubricated at regular intervals and if cast iron is being machined, the chucks should be completely disassembled and completely cleaned occasionally.

Many power chucks have been in continuous operation for the past 15 to 18 years without needing any major repair. The simplicity of design and ruggedness of construction are the big factors in their long life. They are usually built of a one piece steel body, re-inforced with radial ribs so as to give them the needed strength to withstand the very rugged service requirements. All other parts of the power chuck are designed of the best material possible, using various alloy steels.

Table III. Theoretical clamping forces obtained with power chucking equipment

Chuck Size (inches)	Cylinder Size (inches)	Lever Ratio in Chuck	Theoretical Clamping Force (pounds, at 80 psi line pressure)
6	3	2 to 1	1,130
10	8	2 3/8 to 1	9,549
12	10	2 7/8 to 1	18,063
15	14	3 3/8 to 1	41,563
18	14	4 to 1	49,260
24	20	5 to 1	125,660



Systematic, planned maintenance helps Hammermill to get added production from existing equipment. Here, W. R. Whitley, Maintenance Superintendent, co-ordinates maintenance projects at foreman level assigning priorities to jobs scheduled for the week ahead.

Hammermill averts breakdowns with Productive Maintenance

Planned overhauls and routine maintenance assure higher output... lower costs... smoother work flow

If their huge Number 7 paper machine fails, the Hammermill Paper Company of Erie, Pennsylvania, can lose almost 30% of its productive capacity. Naturally, Hammermill finds it pays to prevent breakdowns by reinforcing routine maintenance with systematic, *planned* equipment overhauls.

It will pay you, too. Planned overhauls—key to Productive Maintenance—minimize downtime because you can provide for needed maintenance manpower, equipment replacements and renewal parts on a scheduled basis. Planning substantially reduces overtime repair costs, lost production and man-hours, spoilage of material in process, and inevitable waste motion that result from unforeseen breakdowns. And because they can be co-ordinated with production schedules, planned overhauls assure smoother work flow, and more reliable deliveries.

Get more output from existing equipment by putting Productive Maintenance to work in your plant. To help win management support, General Electric offers maintenance men a "kit of tools" that tells what Productive Maintenance is, how it works in typical plants, what it can do for you. Ask your G-E Apparatus Service Shop representative for full details, or write to General Electric Company, Section 801-10, Schenectady 5, N. Y.

Productive Maintenance—is important as production itself

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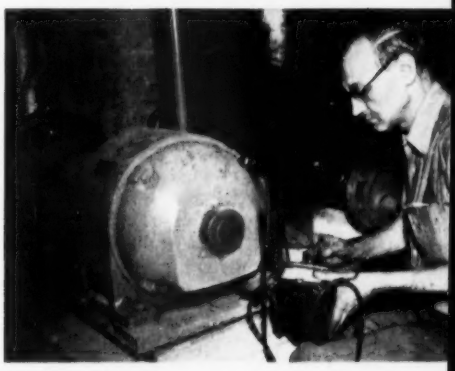
With 24-hour operation maintained by planned overhauls, No. 7 paper machine turns out 180,000 to 190,000 pounds of fine paper per day.

Efficient records system assures proper meshing of routine maintenance and planned equipment overhauls in the daily work assignments.



Routine maintenance is reinforced by planned overhaul to help keep Hammermill's 225-acre mill operating at optimum capacity.

Easy-to-use G-E kit of helpful maintenance information shows how you can put *Productive* Maintenance program to work in your plant.

Telescoping Boom Adds "Stretch" to Fork-Lift Truck

Bar stock shipped to the screw machine plant of Northwest Automatic Products Corp., Minneapolis, is handled by a telescopic crane fitted on a fork lift truck.

Designed and built under the direction of the company's engineers, the crane solved the problem of handling heavy, bulky bundles of steel and brass bar stock. The bundles range from 10 ft to 16 ft in length and from 2000 lb to 10,000 lb in weight.

Basically, the device is a telescopic boom with a hook at the end. The boom can be extended, like a telescope, to a length of 10 ft by turning a hand crank on the frame. The boom is bolted to the mast of the fork-lift truck, and can be raised and lowered as desired. Another hook is installed at the base of the boom to carry loads too heavy for the end hook.

When unloading bundles of bar stock from an open-sided truck, the fork truck boom is extended over the center of each bundle of stock and a wire rope sling hung from the hook is used to pick up the bundle. Inside the plant, the bundles are stored on horizontal

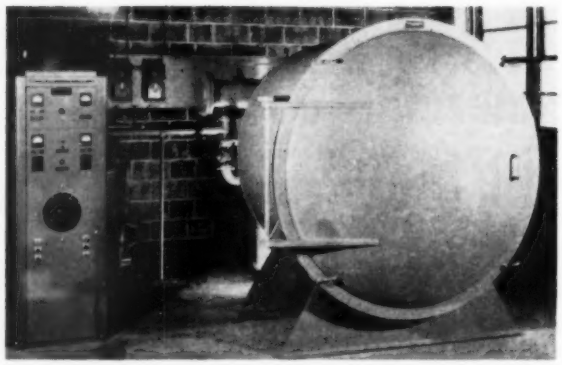
racks set at a 45-deg angle to facilitate maneuvering by the fork truck. The crane unit, built at a cost of $1000, permits two or three men to unload and store a shipment of bar stock in less than an hour. It is mounted on a 10,000-lb capacity Clark lift truck.

Oversize Vacuum Metallizing Unit for Extraordinary Plating Jobs

Objects which formerly have been uneconomical to metallize because of their large size get special consideration with new 66-in. vacuum metallizing units in operation at the Vacuum Metallizing Corp., Long Island City, N. Y., the world's largest custom metallizers.

With the vacuum process, an initial coating of lacquer is applied to the surface of the object to be finished just as it comes from the mold. Then a very thin film of evaporated aluminum is added, with a final coating of clear lacquer to provide durability to the mirror-like aluminum finish. The top coat of lacquer can then be dipped into a water-soluble transparent dye with a resulting brilliant metallic finish.

The vacuum metallizers were developed and built by High Vacuum Equipment Corp., Hingham, Mass.



Pilot Plant Developed for Mechanized Production of Electronic Parts

An automatic production line for the manufacture of electronic products and a novel system of electronics design which makes this possible have been developed by the National Bureau of Standards. The program, code-named Project Tinkertoy, was sponsored by the Navy Bureau of Aeronautics.

Starting from raw or semi-processed materials, machines automatically manufacture ceramic materials and adhesive carbon resistors, print conducting circuits, and mount resistors, capacitors, and other miniaturized component parts on standard uniform steatite wafers. The wafers are stacked very much like building blocks to form a module that performs all of the functions of one or more electronic stages. Automatic inspection machines check physical and electrical characteristics of the parts-mounted wafers at numerous stations along the production line. The completed module is a standardized, interchangeable subassembly combining all of the requirements of an electronic circuit with ruggedness, reliability, and extreme compactness.

The production system largely utilizes non-critical

raw materials. Ceramic wafers—⅞ in. square by 1/16 in. thick—are produced directly in quantity from the raw ingredients. Ceramic capacitors are produced in a similar fashion. Another part of the line produces adhesive tape resistors.

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Oakland—Pacific Elec. Motor Co.
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San Francisco—Weidenthal-Gostiner Electric Works

COLORADO
Denver—Baker Electric Company

CONNECTICUT
Hartford—Charles H. Leppert
Waterbury—Elec. Motor Repair Co., Inc.

FLORIDA
Jacksonville—Turner Electric Works
Miami—Peninsular Armature Works
Tampa—Tampa Armature Works, Inc.

GEORGIA
Albany—Georgia Electric Co.
Atlanta—Bearden-Thompson Elec. Co.
Columbus—Smith-Gray Electric Co.

ILLINOIS
Chicago—Chicago Electric Co.
Marion—Giles Arm. & Elec. Wks., Inc.
Mt. Vernon—Dowzer Electric Machinery Works, Inc.

INDIANA
Indianapolis—Scherer Electric Co., Inc.
Evansville—Evansville Elec. & Mfg. Co.

IOWA
Sioux City—Smith Elec. & Supply Co.

KANSAS
Salina—Cent. Kans. Elec. Mach. Co.
Wichita—Tarrant Electric Mach. Co.

LOUISIANA
New Orleans—Industrial Elec., Inc.
Shreveport—Shreveport Armature & Electric Works

MAINE
Brewer—Stanley J. Leen Co.

MARYLAND
Baltimore—Keystone Electric Co., Inc.

MASSACHUSETTS
Lawrence—Roland B. Glines Co.
Springfield—Elec. Motor Repair Co.

MICHIGAN
Detroit—Stecker Electric Company
Grand-Rapids—Grand Rapids Industrial Electric Co.
Saginaw—Banning Elect. Prod. Corp.

MINNESOTA
Duluth—Mielke Electric Works, Inc.
Minneapolis—Parsons Elec. Co.

MISSISSIPPI
Vicksburg—Ludke Electric Co., Inc.

MISSOURI
Kansas City—Boese-Hilburn Elec. Co.
St. Louis—French-Gerleman Elec. Co.
Springfield—Springfield Elec. Serv. Co.

NEBRASKA
Omaha—Omaha Electrical Works

NEW HAMPSHIRE
Concord—A. S. Tracy

NEW JERSEY
Atlantic City—Charles A. Buckley
Paterson—Elec. Service Repair Co.
Trenton—Lockwood Elec. Motor Serv.

NEW MEXICO
Albuquerque—Electric Motor Company
Powell Electric Co.

NEW YORK
Buffalo—Robertson Electric Co.
Volland Elec. Equip. Co., Inc.
Flushing—Flushing Elec. Corp.
Jamestown—A. E. Westburgh
Mt. Vernon—H. A. Schreck, Inc.
New York—Consol. Elec. Motor Co.
Rochester—Vanderlinde Elec. Corp.
Utica—Mather, Evans & Diehl Co.
Watertown—Watertown Elec., Inc.

NORTH CAROLINA
Charlotte—Southern Elec. Service Co.
Greensboro—Southern Elec. Serv. Co.
Rocky Mount—Hammond Elec. Co.

OHIO
Cincinnati—Cincinnati Elec. Equip. Electric Service Co.
Akron—A-C Supply Co.
Toledo—Romanoff Elec. Motor Serv.
Youngstown—Winkle Electric Co.

OKLAHOMA
Miami—Miami Armature Works
Oklahoma City—Southwest Elec. Co.
Tulsa—Smith-Milligan Electric Co.

OREGON
Eugene—Kalen Electric & Mach. Co.
Portland—Milwaukee Mach. Co.

PENNSYLVANIA
Johnstown—Universal Elec. Mfg. Co.
Osceola Mills—Mid-State Elec. Eng. Co.
Philadelphia—Elec. App. & Repair Co.
Pittsburgh—Penn. Elec. Coil Corp.
York—Industrial Electric Company

SOUTH CAROLINA
Greenville—Southern Elec. Serv. Co.
Spartanburg—Southern Elec. Serv. Co.

SOUTH DAKOTA
Sioux Falls—Electric Motor Repair

TENNESSEE
Columbia—Middle Tenn. Arm. Wks.
LaFollette—Standard Arm. Works, Inc.
Memphis—Indus. Elec. & Supply Co.

TEXAS
Amarillo—G. E. Jones Elec. Co.
Beaumont—Elec. Mach. & Repair Co.
Dallas—Industrial Elec. Equipment Co.
El Paso—B & M Machinery Co.
Fort Worth—Central Electric Co.
Houston—Roy A. Berentz Co.
Sweetwater—Sweetwater Electric Co.

UTAH
Salt Lake City—Diamond Electric Motor Repair

VIRGINIA
Richmond—Wingfield & Hundley
Roanoke—Virginia Armature Co.

WASHINGTON
Spokane—Lee F. Austin Company

WEST VIRGINIA
Charleston—Charleston Elec. Supply
Fairmont—West Virginia Armature Co. of Fairmont, Inc.
Morgantown—Galis Elec. Repair Co.

WISCONSIN
Baraboo—Utility Trans. & Equip. Co.
Green Bay—Beemster Electric Co.
Milwaukee—Dietz Electric Co.
Wausau—Electric Motor Service
Wisconsin Rapids—Staub's Elec. Wks.

ALLIS-CHALMERS CERTIFIED SERVICE SHOPS are independent service shops which have met rigid standards for ability, experience, equipment and business integrity. They use factory approved methods and parts and do your work promptly at a fair price.

Of course, Allis-Chalmers Certified Service Shops give good service on any electrical equipment, of any make. Tear out this ad and save it, or write the name of the A-C Certified Service Shop nearest you in your address book. Allis-Chalmers, Milwaukee 1, Wisconsin. A-4197

Texrope and *Vari-Pitch* are Allis-Chalmers trademarks.

Sold . . .
Applied . . .
Serviced . . .

by Allis-Chalmers Authorized Distributors, Certified Service Shops and Sales Offices throughout the country.

CONTROL — Manual, magnetic and combination starters; push button stations and components for complete control systems.

TEXROPE **— Belts in all sizes and sections, standard and *Vari-Pitch* sheaves, speed changers.**

PUMPS — Integral types from ¾ in. to 72 in. discharge and up.

ALLIS-CHALMERS

For more facts circle 561 on Reply Card

Magnetic Grids "Filter" Pigment Powders to Screen Out Iron

Particles of rust weighing fractions of an ounce, large bolts and iron scrap are the major causes of product contamination, machinery damage, and fire-breakouts in the process lines of the chemical pigment industry. At the Kentucky Color and Chemical Co., Inc., Louisville, the company has installed grate and hopper magnets, one of the latest developments of the Eriez Mfg. Co., Erie, Penna., to combat these production problems.

Processing dry color pigments prior to magnetic separation of tramp iron consists of forming a filter press cake, drying it, then breaking and pulverizing to reduce particle size below 10 microns.

The permanent non-electric grate and hopper magnets, installed at the top and throat of the hopper on the pulverizing mills, prevent tramp iron from entering.

Both magnets process several hundred types of pigments poured in the mills, with output varying from 500 lb to 3000 lb per hour.

The grate magnet, protected from damage by a rugged steel grill across the hopper opening, is about 32 in. square, and consists of 1-in. diameter stainless steel tube containing powerful Alnico V cast magnets. The throat magnet separator is composed of steel discs

spaced on 1 in. centers with cylindrically shaped Alnico V castings occupying the spaces between the discs. The end discs contact the two sides, providing a magnetic barrier covering the entire hopper discharge opening.

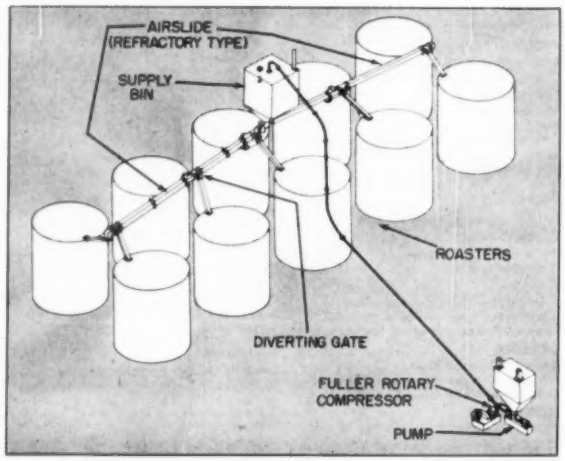
Company officials state that the eight pairs of magnets in their plant provide estimated annual savings of $6000 in repair time, lost time and fire losses.

Refractory Carrier Medium for Conveying Hot Dust Pneumatically

Dust recovered by Cottrell precipitators during the roasting of metalllic sulfides is returned to roasting furnaces for reprocessing at temperatures from 500 F to 800 F, by a special pneumatic conveying system at the Noranda Smelter, Noranda, Quebec.

From a collecting hopper fed by the precipitators, the dust is gravity-fed into a Fuller-Kinyon pump. The screw element in the pump feeds it into an air-mixing chamber. Here, the dust is made fluent by suspending it in compressed air. From the mixing chamber, compressed air at 15 psi forces the dust through a conveying line to a supply bin located above the roasters.

Dust is fed uniformly from the supply bin to ten roasters through an F-H Airslide, which is a conveyor containing an enclosed inclined porous medium (in this application, refractory aluminum oxide is used) which supports the stream of dust. Fluidized by low-pressure air, the dust flows by gravity. Conveyor equipment was made by the Fuller Co., Catasauqua, Pa.



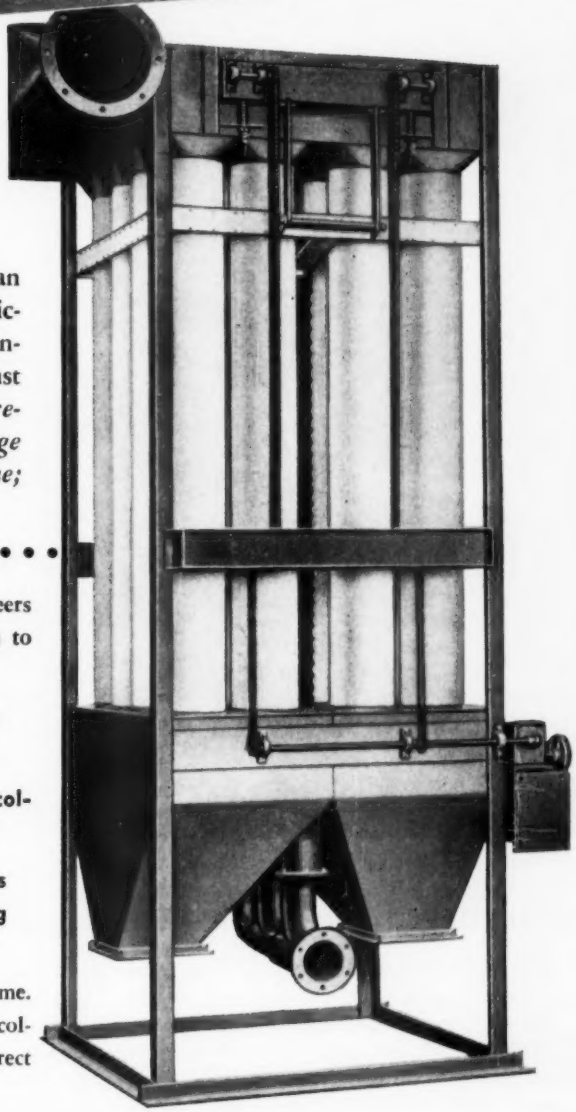
Workshop on Wheels Brings Abrasive Knowledge to Industry

New and unique mobile unit that is equipped to demonstrate coated abrasive grinding under actual production conditions, has just been announced by The Carborundum Company, Niagara Falls, New York.

Contained in the 19-ton workshop is a total of eight stationary coated abrasive grinding machines and a variety of portable tools which are demonstrated in actual production grinding operations. The selection of tools is so complete that it virtually covers the range of representative applications and potential uses for coated abrasives in the metals industry.

More than 20 grinding demonstrations have been devised, representing a wide variety of typical grinding operations. Only a selected grouping is presented at any one time in keeping with audience interest.

Introducing AMERjet



A better REVERSE JET TYPE FABRIC DUST ARRESTER Built to exacting AAF design and performance standards

Just what you'd expect from the leader! American Air Filter has developed and field tested a fabric-type dust arrester incorporating the same basic concept and design features found in all AAF Dust Control Products, namely—*small space requirements; maintained performance over a wide range of operating conditions; constant exhaust volume; high collection efficiency.*

With these proven advantages established, AAF engineers then "iced the cake" with these additional features to further increase AMERjet's over-all efficiency—

- **Tension control to compensate for variation in fabric dimensions due to humidity changes.**
- **Rugged, foolproof mechanism for dislodging collected material with high pressure jets.**
- **Venturi-shaped inlet for dust-laden air extends life of cloth by greatly reducing the abrading effect.**

AMERjet is available for handling any exhaust volume. For complete information on this new dry-type dust collector, call your local AAF representative or write direct for Bulletin No. 279.

AAF

American Air Filter

COMPANY, INC.

228 Central Avenue, Louisville 8, Kentucky • American Air Filter of Canada, Ltd., Montreal, P. Q.

For more facts circle 562 on Reply Card

AN INSPECTION STATION—CUSTOM BUILT with Standard HALLOWELL Shop Equipment

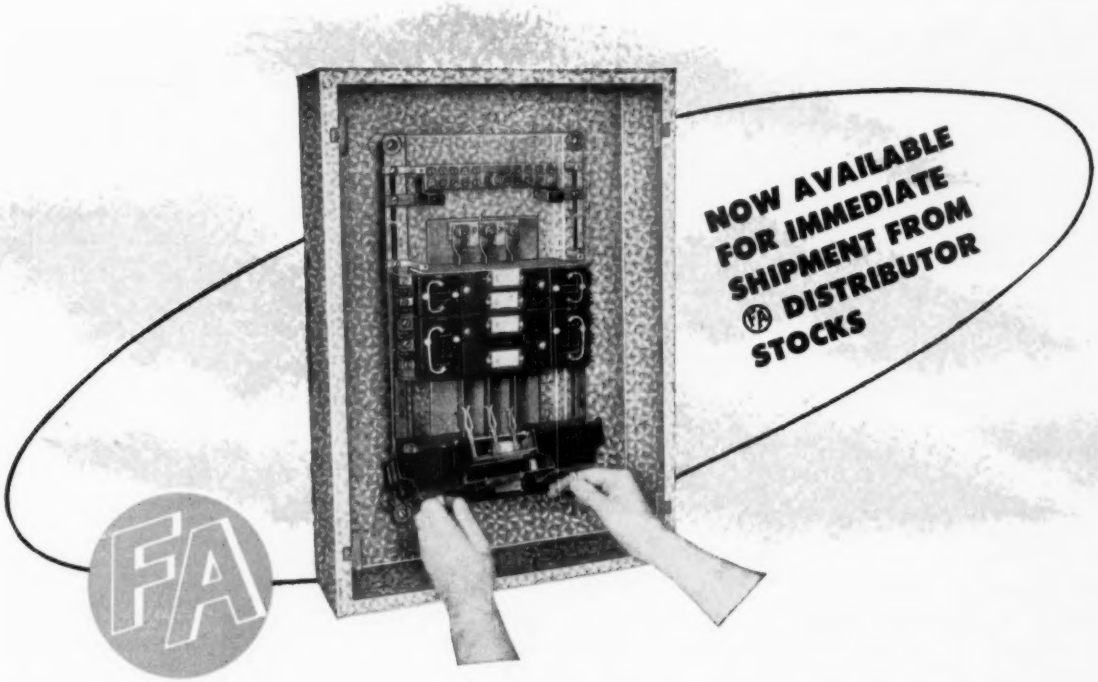
To set up an inspection station anywhere in your plant is a simple operation with HALLOWELL Shop Equipment. All you have to do is design it as you want it and order standard, ready-made units from your HALLOWELL distributor. Write for complete details. STANDARD PRESSED STEEL CO., Jenkintown 26, Pa.

Our Fiftieth Year : A START FOR THE FUTURE

1. Cabinet Benches 2. Stools and Chairs

HALLOWELL® SHOP EQUIPMENT DIVISION SPS JENKINTOWN PENNSYLVANIA

For more facts circle 541 on Reply Card



PLUG-IN feeder distribution PANELBOARDS

You'll save time, labor and money by using this new type panel for all your feeder distribution needs. Approved by the Underwriters' Laboratories, Inc., for label service, these new and improved panels are of the "panel base assembly" type, which means that mounting back with main bus bar and lugs, box and front, and required switching units are readily available from FA distributor's stocks for quick and easy assembly on the job. (Factory assemblies also available.)

Two dependable FA switching units — the Pulfuzswitch and the Klampswitchfuz — make these panelboards the finest in safety and efficiency. Both types combine switch and fuse in one unit so that current is "off" when the fuse carrier is removed and the door opened. This makes replacement of fuses safe, quick and easy.

Boxes are standardized in width, height and depth to meet almost any combination or job requirement. Standard knockouts in ends are provided in 19″ wide boxes; removable ends to permit drilling of conduit openings on the job are provided in the 24″ wide boxes. Generous wiring space and ease of installation are other features of these new and better panelboards.

Another extremely popular feature of these new assemblies is that they are expandable. Not only do they provide the branch circuits needed for today but they are so designed that future additions of circuits and changes in capacity are a simple matter of plugging in new units.

Use these new panelboards for all your feeder distribution needs. Capacities are, 250 volt AC or DC and 600 volt AC service, 200, 400 and 600 ampere mains and 30, 60, 100 and 200 ampere, 250 volt branches; and 30 and 60 ampere, 600 volts, all in the 24″ boxes. 200 ampere, 250 volt maximum mains, 30 and 60 ampere maximum branches (illustrated above) in 19″ boxes.

For further information about these new and extremely efficient panelboards, see your nearest FA Distributor or consult your nearest FA Representative listed in Sweet's.

Frank Adam Electric Co.

BOX 357, MAIN P. O.
ST. LOUIS, MISSOURI

Makers of BUSDUCT • PANELBOARDS • SWITCHBOARDS • SERVICE EQUIPMENT • SAFETY SWITCHES • LOAD CENTERS • QUIKHETER

For more facts circle 563 on Reply Card

NEW PRODUCTS & PROCESSES

summarized for your convenience

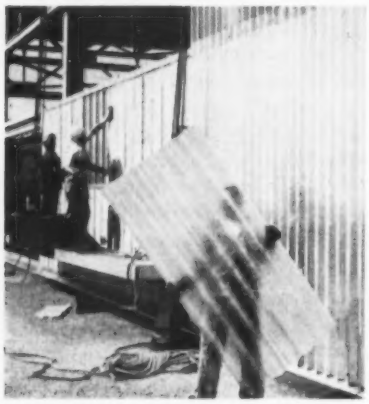
Edited by M. E. Heniken

1—LEVEL CONTROL is improved capacitance unit

The new Tektor Level Control is an improved capacitance unit with no moving parts. It is designed to provide control as close as 1/16 in. of liquid, divided solid, interface, conducting or non-conducting, wet or dry materials. The simplified electronic circuit operates by a change in the electrical capacitance of the electrode caused by the approach of any material that flows. The electrodes are available for use with pressures up to 1500 F. Only a single radio tube is employed. The control operates on 115-v 60 cycle power supply. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

2—STRUCTURAL SHEET for V-beam construction work

A new translucent structural sheet of Fiberglas-reinforced polyester resins is termed "V-beam" and nests with corrugations of available protected metal roofing and siding sheets, designed for wider purlin and girt span. The greater



corrugation depth serves to provide increased rainfall runoff capacity for roofs of low pitch. The sheet is available in lengths to 12 ft, and the overall width is 29 in. Coverage width is 26½ in.; corrugation pitch is 5.3 in. and depth 1¾ in. While the sheet will be available in 10 standard colors, normal production will include pale green, ice blue and semi-clear for the skylights and side wall glazing of industrial buildings of V-beam construction. As manufacturer points out, such construction is economical because it eliminates flashing, caulking and special framing. The material is described as shatterproof and unaffected by weather extremes. Resolite Corp.

3—TEMPLATE for drawing outlines of screw threads

A range from 20 threads per inch to 4 threads per inch of the most commonly used American Standard threads is covered in the No. 15 Screw Threads Template. With this range it encompasses standard screw diameters from ¼ to 4 in. The template is made of plastic with smooth cut-outs. It is 6⅞ by 2¾ in., costs around $2.50. RapiDesign, Inc.

4—METAL LAMP SHADE stays comfortable to the touch

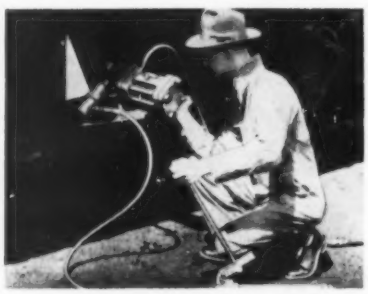
An incandescent metal shade, the Coolite is said to remain comfortable to the touch even after long hours of use with a 100-w lamp. Available in four models, the Coolite Shade is part of this manufacturer's new Dextra-Lite line of universally adjustable incandescent and fluorescent lighting units. According to company, Coolites help eliminate the hazard of burns from hot shades on incandescent lighting units. They can be used on machine tools, work benches, and wherever people must work close to their source of light. Bulletin 134 describes them. Swivelier Co. Inc.

5—STEAM TRAP, of cast steel, has integral strainer

The No. 983 is a cast steel side inlet, side outlet trap with integral strainer. Its mechanism is corrosion resistant stainless steel, identical in design and construction to that used in this manufacturer's traps for 900 F, 950 psig duty. The built-in strainer affords efficient operation where dirt and scale conditions are bad. Pressure range of this new trap is from 0 to 600 psig, and maximum capacity is 4400 lb-hr. Connections are ½, ¾ or 1 in., screwed, flanged or socket weld. Armstrong Machine Works.

6—AIR VIBRATOR is a powerful, portable unit

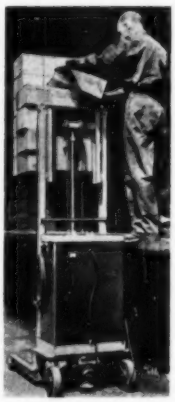
Railroad cars can be unloaded quickly with the Type HCRR Vibrator, says the manufacturer of this compact unit. Described as easy to handle and operate, it is equipped with a hydraulically operated mounting clamp for quick attachment to railroad car or other materials handling unit. The vibrator speeds the handling of sand, cement, coal, ore, cinders and other materials—after they are removed from the car it can keep them moving from or into bins, chutes. The Cleveland Vibrator Co.



More information on any of these products can be yours without cost or obligation. Just circle the item numbers on the Reader Service Cards on pages 35-36 and 149-150.

7—LIFTING UNIT handles loads of 750 to 1000 lb

Being battery-operated, the WorkLifter may be used anywhere, manufacturer points out. Two heavy-duty batteries connected in series provide power for day-long continuous duty or for several days of intermittent use. Batteries are recharged by plugging the charger cord into any 110-v, a-c electric receptacle. The charger is built in and mounted on the wall of the battery compartment. A circuit breaker serves to prevent damage by overcharging.



The WorkLifter is rated at 750 lb; its maximum safe capacity is given as 1100 lb. Its overall height is 6½ ft, and the lift operates from 5¼ in. above floor to a height of 5 ft. The basewheels are 8-in. dia solid rubber swivel casters and the fixed wheels are 5 in. dia solid rubber, all with roller bearings. The machine has a foot-operated floor lock. The hoist unit is an electric-hydraulic gear operated pump, with pushbutton control for raising and lowering. Economy Engineering Co.

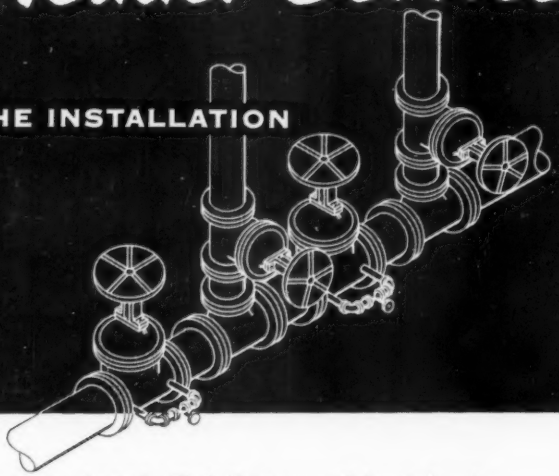
8—CLUTCH CONTROL steps up press production

Micro Trip, a two-hand clutch control for manually operated power machines is said to increase production up to 25 per cent and afford complete protection for operators and set-up men. It is available as a package for installation on existing presses. Installation on manually operated power machine usually results in a gain in production, manufacturer points out, because it has an instantaneous electrical response and a light touch actuation that reduces operator fatigue. Also contributing to increased production is the assurance of safety given an operator.

According to company, the device prevents tying down or cheating because its two control switches must be pressed simultaneously to operate the press; if one switch is pressed before

Holding Tight Since 1917 On Boiler Header Service

THE INSTALLATION



In power plant of a U. S. Government Arsenal, using Crane 14-inch 300-pound steel gate valves in main steam header operating at 135 pounds, 380 degrees F.

VALVE SERVICE RATINGS

SUITABILITY: *No failure in 36 years*

FEATURES: *100% heavy duty design*

MAINTENANCE COST: *No repairs to date*

SERVICE LIFE: *Installed 1917 – still O.K.*

OPERATING RESULT: *Increased plant efficiency*

AVAILABILITY: *Crane catalog item – Current No. 33XR*

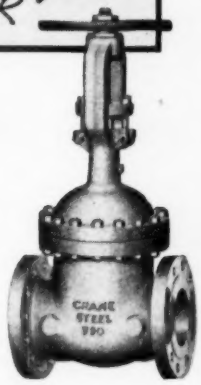
THE CASE HISTORY

Installed in 1917, these Crane valves have given completely satisfactory service for 36 years without needing repairs of any kind. Inspected in 1951, they showed no undue wear in any part, and a 125-pound hydrostatic test found them absolutely tight. Right back into the header they went, where they're still giving like-new service.

In a period of plant expansion, other makes of valves were tried in the same header service. But those valves gave constant trouble, whereas when replaced with Crane valves, satisfactory results were obtained.

Here's an example of the confidence you can put in a name that traditionally means better quality. For what good is a price without the assurance of product dependability and good value. You're safer—always—when you choose Crane.

THE VALVE



Here is steel casting skill at its best, by the pioneer in steel valves. Here also is leadership in design and manufacturing that sets Crane Steel Valves apart from the ordinary. Choose these valves for your specific needs from the widest range of body and trim materials, in all pressure classes and sizes, with flanged, screwed, or welding ends. See your Crane Catalog.

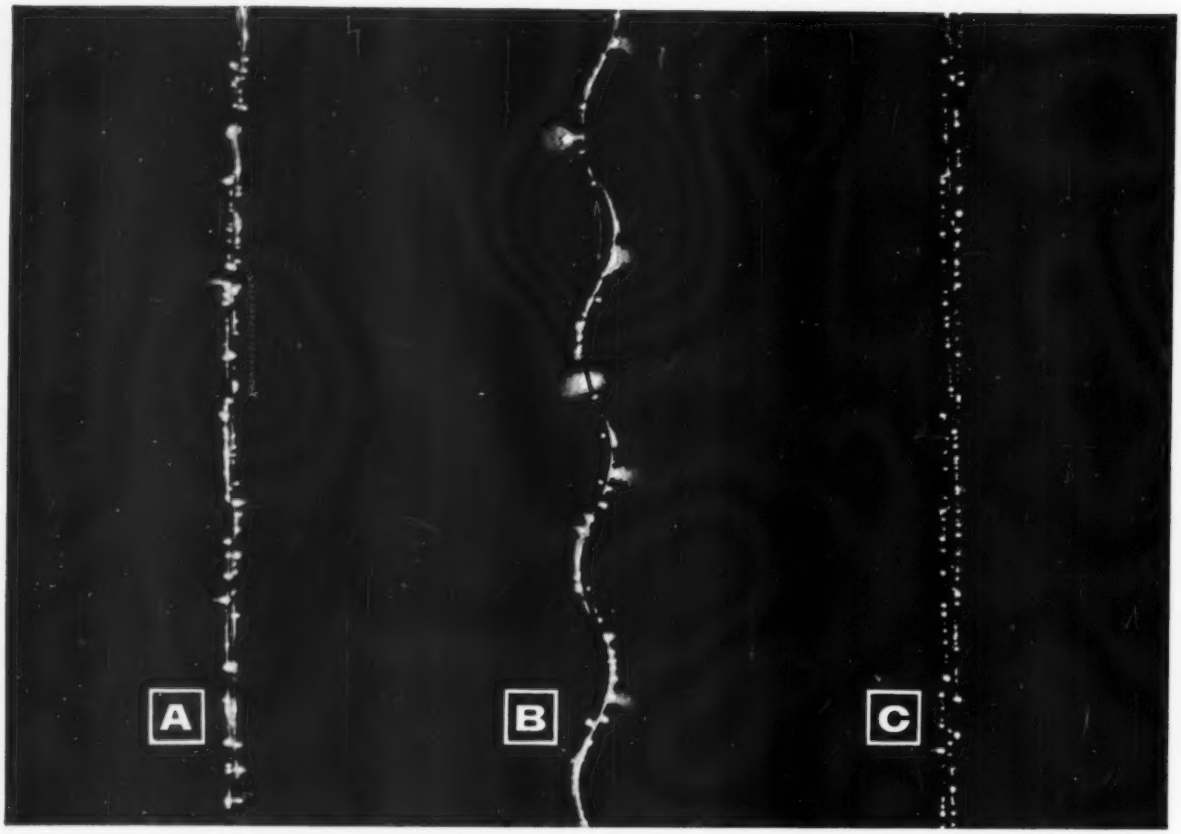
THE BETTER QUALITY... BIGGER VALUE LINE... IN BRASS, STEEL, IRON

CRANE VALVES

CRANE CO., *General Offices:* 836 S. Michigan Ave., Chicago 5, Illinois
Branches and Wholesalers Serving All Industrial Areas

VALVES • FITTINGS • PIPE • PLUMBING • HEATING

For more facts circle 564 on Repy Card



The A B C of Electric Precipitation

The efficiency of *any* electric precipitator depends on the quality of the corona emission from the electrode, for it is this emission that 'charges' the dust.

Pictured above are the three most frequently used electrodes for doing this job. You can see the quality of the corona for yourself. We'll be glad to give you an actual demonstration.

Other precipitators use electrodes A and C which give off only fair emission. Use of fine wire (to increase emission) leads to structural weakness. Use of heavy wire (to give strength) means poor emission.

The exclusive Buell Spiralectrode (B) combines strength with peak emission.

The outstanding on-the-job performance of the new Buell Spiralectrode is typical of the advances made by Buell Engineers. Continuous-cycle rapping, for example, proved in service for 20 years has *never* caused "puffing".

Buell has consistently led the way to greater efficiency, through a long series of technical discoveries and advances, in all types of dust collection.

Get all the facts. Send for our informative brochure—The Collection and Recovery of Industrial Dusts. It explains all three Buell Systems of industrial dust collection. Send for your copy today. Write Dept. **14L,** Buell Engineering Company, 70 Pine Street, New York 5, New York.

buell®

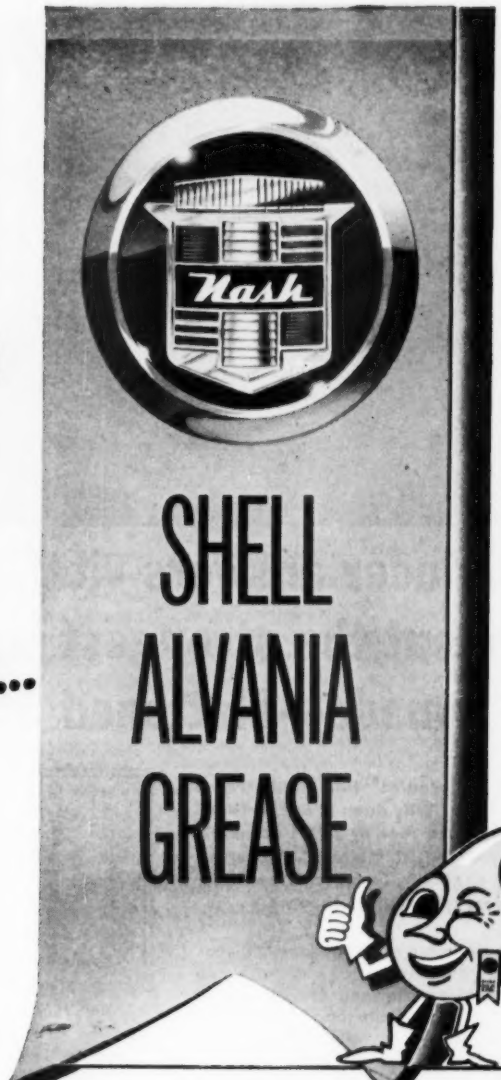
MECHANICAL ELECTRICAL

20 Years of Engineered Efficiency in
DUST COLLECTION SYSTEMS

For more facts circle 649 on Reply Card

95% of the production machinery at Nash Motors' El Segundo, California Plant

is lubricated with a single grease...



RECENTLY, the El Segundo plant of Nash Motors replaced the 12 to 15 greases they were using with a single multi-purpose grease . . . Shell Alvania.

Here, as in many other plants, Shell Alvania Grease has made a vast difference. Immediate savings were made. The new lubricant cut the cost of handling many special greases. It reduced bookkeeping, inventory and overhead . . . offered more favorable bulk purchasing economies. In addition, Alvania reduced application equipment by 75%.

The real difference was in performance. Bearing failures and breakdown are now at an all-time low. Repair bills in one department were running hundreds of dollars before the change in lubricants. Now, with Shell Alvania Grease, this same department reports that repairs are practically non-existent.

Here are some of the advantages of Shell Alvania Grease:

1. Shell Alvania Grease flows *freely* in cold temperatures, yet will not run out of bearings under excessive heat.
2. Ideal for wet, humid applications . . . it resists water emulsification.
3. Shell Alvania Grease has extremely high oxidation stability.
4. You'll find that Shell Alvania Grease extends time between greasings . . . a substantial saving in labor and grease.
5. Simple inventory . . . just the one grease to stock and apply.

Shell Alvania Grease can be the answer to a more efficient lubricating program in your plant. For further information write to Industrial Lubricants, Shell Oil Company, 50 West 50th St., New York 20, N. Y.,—or 100 Bush St., San Francisco 6, California.

SHELL

SHELL ALVANIA GREASE

The True Multi-Purpose Industrial Grease

For more facts circle 565 on Reply Card

Engineer answers vital questions about the strongest wire rope made—Flattened Strand

What is Hercules® flattened strand wire rope? Why does it outperform round strand rope by 2 to 1 or more? Can you use it? Walter C. Richards, chief engineer, Leschen Wire Rope Division, tells you the answers.

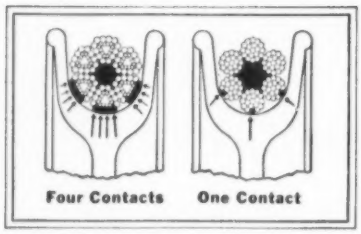
More and more wire rope users are continually experiencing or hearing about spectacular performances of Hercules Flattened Strand wire rope. The explanation is clear.

First, Hercules Flattened Strand is a Super-rope because it packs 10% more steel than any round strand rope of the same size. It's 10% stronger... 10% safer.

Second, Hercules Flattened Strand wears longer and more evenly. That's because there are four wires per strand contacting sheave grooves instead of one.

Third, Hercules Flattened Strand resists crushing and internal strand-cutting, because strands rest snugly against each other, keystone fashion, with less internal pressure or friction.

Fourth, Hercules Flattened Strand prolongs its own life and the life of equipment, because the relatively smooth surface of the rope prevents corrugating and wear on sheave grooves.



With Flattened Strand, notice how four wires per strand contact sheave grooves —reducing rope and equipment wear.

Can you use it?

It's a known, proved fact that no other wire rope made can equal Flattened Strand on applications such as hot ladle cranes, skip hoists, and dredge ropes. It is also best on a variety of other equipment both large and small. For many uses, it is truly a Super-rope.

But, the question is, can *you* use it to advantage? That can be answered only by a qualified wire rope engineer who is thoroughly acquainted with the characteristics and proper uses of Flattened Strand rope.

Check with the authority

That means, check with Leschen. It's wise to do so because Leschen pioneered and perfected Flattened Strand wire rope. Leschen developed special machines to make it. Leschen conducts continuing research on correct uses. Leschen is the authority.

If you discover you can use this Super-rope—Hercules Flattened Strand—you'll soon begin saving time, labor and money. Why not investigate *now?*

LESCHEN WIRE ROPE DIVISION · ST. LOUIS 12, MISSOURI
The Watson-Stillman Company
(A SUBSIDIARY OF H. K. PORTER COMPANY, INC.)
For more facts circle 566 on Reply Card

NEW PRODUCTS

(Begins on page 110)

the other one, the tripping mechanism becomes inoperative and must be reset by a button on the control box.

Micro Trip may be used with single switch control in applications where one hand is otherwise occupied. It is described as ideal for multiple operator installation. Electrical signal systems can be tied in, and it permits single stroke control for positive mechanical clutch machines and automatic cycling control for hydraulic, pneumatic or friction clutch machines. Micro Div., Minneapolis-Honeywell Regulator Co.

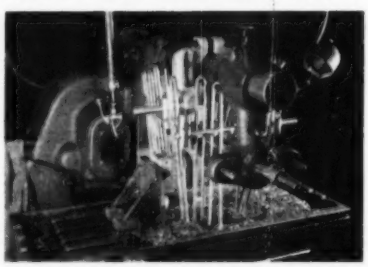
9—SELF-SUPPORTING STAND extends loading dock area

For firms in rented buildings, in old buildings or those with limited dock space, a self-supporting stand is offered by this manufacturer to go with its Herco Dock Boards. The stand simplifies installation, gives greater dock area by putting the loading dock completely outside, it is explained, while it retains the flexibility and heavy-duty features of the loading dock. The stand is installed in front of the present dock, to which it can be welded, or lagged into concrete or wood.

This self-supporting stand was originally developed for plants in rented buildings. Since it does not become a part of the building, the entire stand and dock can be moved when necessary. When the Automatic Herco Dock is bought with this self-supporting stand, it is shipped as a complete unit. For plant engineers who wish to buy only the Herco Dock and build their own stand, the manufacturer will supply blueprints. Karl A. Herman Co.

10—BASKET-TYPE GUARD protects milling machinist

This guard is designed to prevent accidental injury on mills due to operator fatigue, caught sleeves, gloves, etc. Vertical hexagon rods close together form a barrier around three sides of



the rotating cutters. They are adjustable for various table settings, to just clear work, straps and air nozzles. Each vertical rod is locked in place by a thumb screw.

Manufacturer of this guard says it is easily installed on existing mandrels or over arms by means of two heavy V-block castings locked in place wherever desired. No drilling or tapping is required to install the guard on mills

Remington Rand Methods News

Records can make or break plant operation!

Today's alert manufacturing executive needs the right, simplified record-keeping procedures to help increase output from existing facilities . . . at lower cost per unit!

The highly competitive market that exists today makes it vital for plant executives to be on the look-out for new ways to cut back overhead and step up output per machine. All too often, efficient record-keeping methods are overlooked in the search for more efficient manufacturing equipment. However, we think you will find that the right record-keeping methods, used in the right place, can offer you dramatic new savings and stepped up production. Here are the reasons why.

A piece of paper can disrupt your entire plant

Communication through the proper use of paperwork is vital to smooth, profitable plant operation. If records do not provide management with the right facts at the right time so that they may check on and control work flow through all departments, a tremendous and wasteful outlay of time and money and energy can result.

Effective Production Control starts in the Engineering Department

It is in Engineering that Production Control starts. Engineers must understand "how" and "why" manufacturing depends on practical production control techniques. If not, trouble in back ordering, in idle time, shortages, "over expediting" and slow deliveries result.

For the "tough ones" our practical-minded Management Consulting Staff can be called in. These experienced men can uncover trouble spots. They can integrate engineering objectives with production practices by tailor-making the right control methods. They can recommend comprehensive data files for providing fast reference to engineering facts. They can supply specialized equipment for efficiently housing and protecting vital engineering drawings and data. And they can recommend the right types of modern, efficient photocopying equipment for engineering department use.

Materials Management Systems don't cost— they pay!

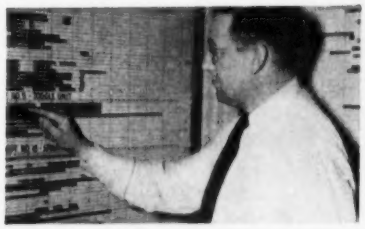
In Material Management you must do more than look at "maximum" and "minimum" figures. Such facts as lead time, value, requirements, availability and economical order quantities must be considered. And here's where your Remington Rand man re-enters the picture. For example, he can recommend an efficient system to develop *precise* material requirements for production scheduling. This is accomplished mechanically and at high speed with punched cards, or with manual methods, depending on the size of your plant's operations. The Remington Rand man may also recommend our Commodity Classification Service. This service: establishes identification by proper nomenclature and numbering; classifies parts, assemblies and raw materials; establishes parts lists, catalogues and data files; establishes interchangeability; etc.

High-speed tabulating equipment at Rotary Lift Co. automatically gives executives fast and accurate Production Control facts in a fraction of the time previously required.

What machines? How much time? How many men?

Rule-of-thumb Scheduling and Machine Loading can lead to costly emergencies. That's why hundreds of plants use Remington Rand manual or mechanical systems to plan the most intelligent use of man-power and machines . . . to speed flow of work through factory . . . to keep jobs in sequence without bogging down. Let us show you how these economical, efficient manual and mechanical systems can be tailored to your needs.

For more facts circle 567 on Reply Card



The plant Superintendent of the Aluminum Goods Mfg. Co. writes: "*Since we took production scheduling out of binders and put machine loading on Sched-U-Graph we no longer use 'Hot Lists' to put on pressure.*"

Answer to Fine Machine Loading . . .

Simplified, visible Sched-U-Graph boards are your most effective way to determine which job will run . . . when it will run . . . and in which work station or machine. Used with manual systems *or* high-speed tabulating machines, Sched-U-Graph provides effective dispatching of jobs . . . enables you to check individual jobs in most economical manner.

Whatever your record-keeping needs, you'll find Remington Rand in a unique position to recommend the machines, equipment or systems best suited for your needs. WE MAKE THEM ALL.

FREE! Fact-filled Manual *"Production Control Systems and Procedures"* (X1268A). This manual provides a well-rounded picture of the theory and practice of effective, money-saving Production Control Systems and Procedures. Sections cover: **Engineering Records • Scheduling • Production • Tool Control • Materials Control.** Mail coupon below.

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Yes, I would like to receive a free copy of the manual: "PRODUCTION CONTROL SYSTEMS AND PROCEDURES" *(X1268A).*

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Company _____

Address _____

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1-16

Profit-Building **IDEAS** For Business

CLARK UTILITRUCS handle the toughest jobs at least cost!

...they're engineered to satisfy driver, maintenance man, management

Here are the most advanced 6000-7000 lb. fork trucks on the market today—Clark's gas or electric UTILITRUCS. Built to handle jobs that break the backs of less rugged trucks, these UTILITRUCS have proved their superiority in foundries, steel mills, stevedoring* and heavy warehousing. They represent an ideal balance of essential engineering features. They get more work done at less cost, for these reasons:

1. Easier to drive

All controls at the driver's fingertips, like an automobile; compact and more maneuverable; shockless steering; increased braking efficiency; 140 sq. inches additional visibility; 25 inches of free-lift; DYNATORK or HYDRATORK DRIVE available on gas model.

2. Easier to service

Complete accessibility for maintenance. On gas model: one-piece "zipper" hood folds back to expose engine; one-piece floorboard lifts up to expose master cylinder and transmission; swing-out battery. All service points easy to reach.

3. Built to take punishment

Welded, integral-unit box frame eliminates distortion; higher inch-pound rating; axle-to-frame mounting absorbs shocks and strains; new design wheel and backing plate seals out dirt and abrasives. Oil bath air cleaner and oil filter standard on gas model. Totally-enclosed drive motor, sealed-for-life bearings on electric model.

We invite you to compare the UTILITRUCS to any 6000-7000 lb. truck on the market! Without obligation, you can discuss them with your nearby Clark dealer, listed in the Yellow Pages of your phone book. Or write us for free descriptive literature.

*Special stevedoring model available

1903 1953 CLARK EQUIPMENT

CLARK EQUIPMENT

Industrial Truck Division
CLARK EQUIPMENT COMPANY
Battle Creek 98, Michigan

For more facts circle 568 on Reply Card

NEW PRODUCTS

(Begins on page 110)

with a single or double round mandrel or over arm, it is pointed out. The guard is designed so that it may be made smaller or larger to accommodate various jigs and pieces. The corner knuckles lock the adjustable horizontal round rods by a clamping action to prevent marring or burring. Searjeant Metal Products, Inc.

11—TROUBLE LAMP for use at hazardous locations

Type EPLH, a lightweight, explosion-proof trouble lamp, has a concentrated beam of light which assists maintenance work at locations where explosive gases or vapors are in the air. It is claimed to be especially practical for inspecting interior areas of oil and gasoline drums or process vessels and tanks, as well as for illuminating inaccessible gages.

It consists of a cast aluminum cylindrical-shaped lamp chamber, concentrating lens, composition handle, support hook and explosion-proof cord

connector with mechanical cord grip. The beam of light concentrated by the lens is supplied by a 12-v auto lamp. An essential accessory for supplying current is an explosion-proof 120/12 volt transformer. It is pointed out that, in case of one or more explosions in the lamp compartment, caused by an arc in the lamp socket, the flame-tight threaded joints around the lens housing and along top and bottom sections of the lamp compartment will confine explosion flames to an area within the lamp compartment. Crouse-Hinds Co.

12—SOLVENT EMULSION to step up cleaning action

Cleaning of oils, grease and dirt from metal surfaces is claimed to be faster, safer and more thorough with Brulinsolv Concentrated Solvent Emulsion Cleaner. When mixed with low cost solvents, such as kerosene, the concentrate acts to step up the cleaning action of the solvent. Manufacturer says the action is similar to that of a detergent in water, and this characteristic permits flushing of the surface with water.

Brulinsolv is described as non-toxic, non-corrosive, free of chlorinated or

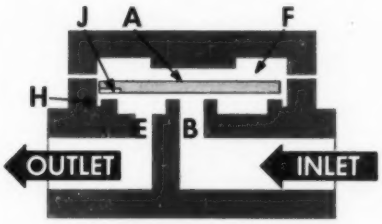
SARCO
Thermodynamic
STEAM TRAP

ACTUAL SIZE

this new trap virtually eliminates maintenance - won't wear out

SOLID STAINLESS STEEL DISC ACTS AS VALVE HEAD

HERE'S HOW IT WORKS!



Air and or condensate raise valve seat disc A, discharge thru E. When steam follows, greater velocity causes it to strike body at H thus building up pressure in chamber F. This causes disc to seat, closing tube B. As pressure in F decreases by condensation and leakage thru slot J, pressure in tube B raises disc and cycle is repeated.

The Sarco Thermodynamic Trap has proved successful on steam mains and separators; headers and soot blower pipes; engine and turbine stop valves, separators and casing drains; alternate heating and cooling applications.

A solid stainless steel disc – practically indestructible – is the only moving part!

Most striking feature of the Sarco *Thermodynamic* Trap is its simple maintenance-free design. There's only one moving part – a solid stainless steel disc that practically lasts forever. There are no other moving parts to wear out or cause trouble.

Condensate, air and steam act directly on the disc valve which opens to discharge condensate and air – snaps shut to contain steam. There are no mechanical devices required to operate valve (see diagram at left). That means practically endless trouble-free operation.

Other advantages: small size, easy installation, not affected by shock or vibration, immunity to corrosive elements with all wearing parts stainless steel, same valve head and seat for all pressures to 600 psi and temperatures to 950° F.

Check these advantages to your own satisfaction at absolutely no cost. We'll send you a trap for free trial. All you do is fill out the coupon and mail it in.

SARCO COMPANY, Inc.
Empire State Building, New York 1, N.Y.

MAIL COUPON TODAY FOR FREE TRIAL

Sarco Company, Inc., Empire State Bldg., New York 1, N.Y.
Gentlemen: Please send me a Sarco Thermodynamic Trap for free trial, requirements as checked.
Size: ½"... ¾"... 1"... Operating Pressure:.....psi

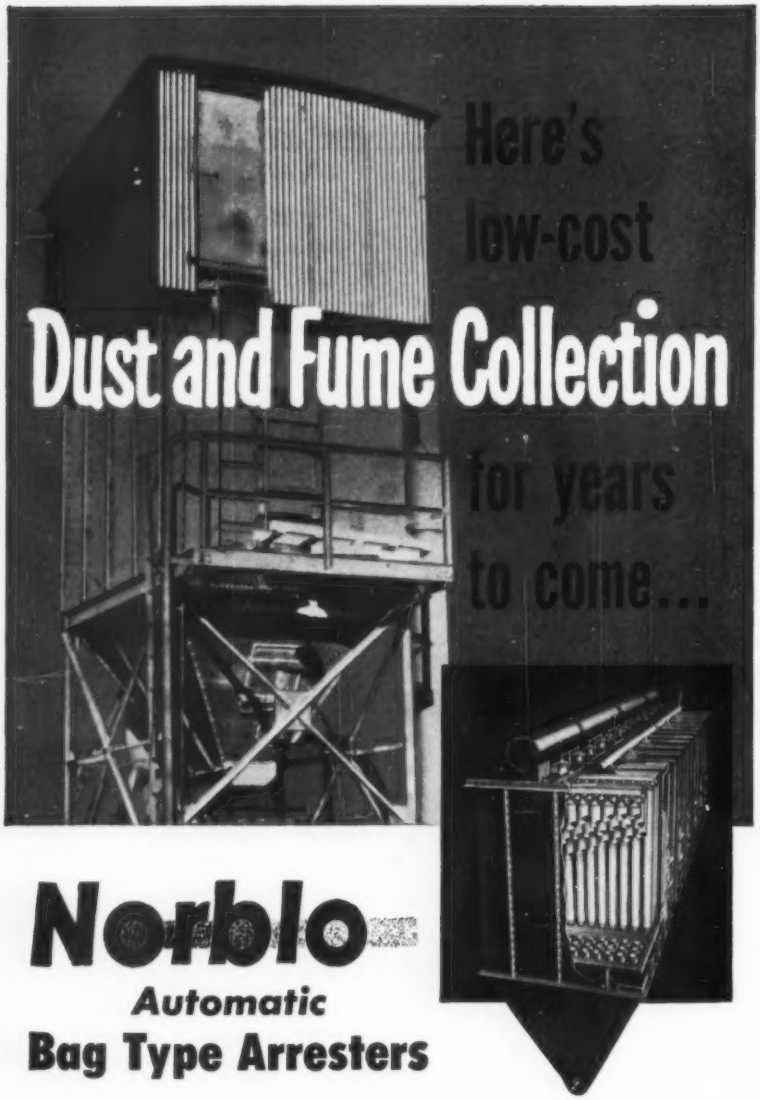
For installation on.....

NAME_____

FIRM_____

ADDRESS_____

CITY_____ STATE_____



Norblo

Automatic

Bag Type Arresters

Norblo equipment is based on sound, experienced engineering and takes full account of the *scale* of your operation as well as *time* factors, so that Norblo performance can be *guaranteed.*

Norblo arrester design is based on multiples of a basic, standardized compartment. Bag cleaning—fully automatic—is cyclic and periodic, taking only a few seconds for each compartment. In continuous, heavy duty operation, full calculated capacity of Norblo equipment is always available, and investment for equipment of any desired capacity is held to a minimum.

Norblo gives you all four essentials of low cost operation for years to come—advanced design, high efficiency, long life and low maintenance. Write for Bulletin 164-4.

The Northern Blower Company

Engineered Dust Collection Systems for All Industries

6423 Barberton Ave. OLympic 1-1300 Cleveland 2, Ohio

For more facts circle 570 on Reply Card

NEW PRODUCTS

(Begins on page 110)

phenolic compounds, and having a pleasant odor. It is suggested for cleaning machinery and equipment, painted or unpainted concrete floors and declared safe enough for cleaning tar and oil from hands. Brulin & Co., Inc.

13—FAUCET WASHER with two new improvements

Utilization of Fiberglas, as a reinforcement, and a special compound are improvements announced for the Easy-Tite Faucet Washer. According to manufacturer of these washers, Fiberglas is unaffected by varying temperatures, requires 1200 F to melt it, doesn't stretch and has a tensile strength of 460 psi as compared with that of 80 psi for cotton duck. It doesn't absorb water and it resists chemicals. The new compound used in these faucets is said to have greater resistance to extreme hot water, to be impervious to water impurities, and to have superior tensile strength to offset spreading, splitting and "mushing" out. These new improvements are designed to produce a faucet washer able to withstand the abuse common to industrial installations and thus cut waste due to leaky faucets. J. A. Sexauer Mfg. Co., Inc.

14—STORAGE BOX handles the very small parts

Increased efficiency in handling small parts is offered by the new, smaller NesTier that complements two larger sizes previously introduced. Made of 20-gage steel, this green-enameled box is designed for handling 200 lb with the standard handle, and 400 lb with a heavy duty handle. It weighs 3 lb, has a volume of 238 cu in.; it measures 12 in. long, 7¼ in. wide and 4¾ in. deep.

Like its big brothers, the new NesTier nests and tiers by flipping the handles at both ends. When nested,

they require only 1/12th the space used for the tiered position. The little tote box is particularly suggested for use in manufacturing operations where small parts must be kept together throughout production and inspection. Since each end of the NesTier has an angled opening, stock can be checked at a glance without removing boxes. They can be

Differential *Pressuretrol* saves $60 strainer replacement

The strainers installed in General Petroleum's terminal are made up of a 100-mesh outer filter, with added layers of 40-mesh and ¼-inch mesh on the inside. As pipeline scale accumulates in them, pressure builds up on the 100-mesh strainer. And before operators would know that anything is going wrong, the strainer would get ruptured.

Every strainer replacement meant a cost of about $60. To cut down on this recurring expense, Mr. D. A. Younger, terminal superintendent, worked out a simple but effective alarm system using a Honeywell Differential *Pressuretrol*. This device watches over the pressure drop across the strainer. The high-pressure tap is connected on the upstream side of the strainer, and the low-pressure tap to the downstream side.

As scale begins to accumulate, upstream pressure increases and downstream pressure drops. The set point of the controller is adjusted to a differential well below the rupture strength of the strainer. The instant that scale build-up reaches this value, the controller's mercury switch trips . . . and actuates an alarm that notifies the operator. The pump is then shut off and the strainer cleaned before any damage can happen.

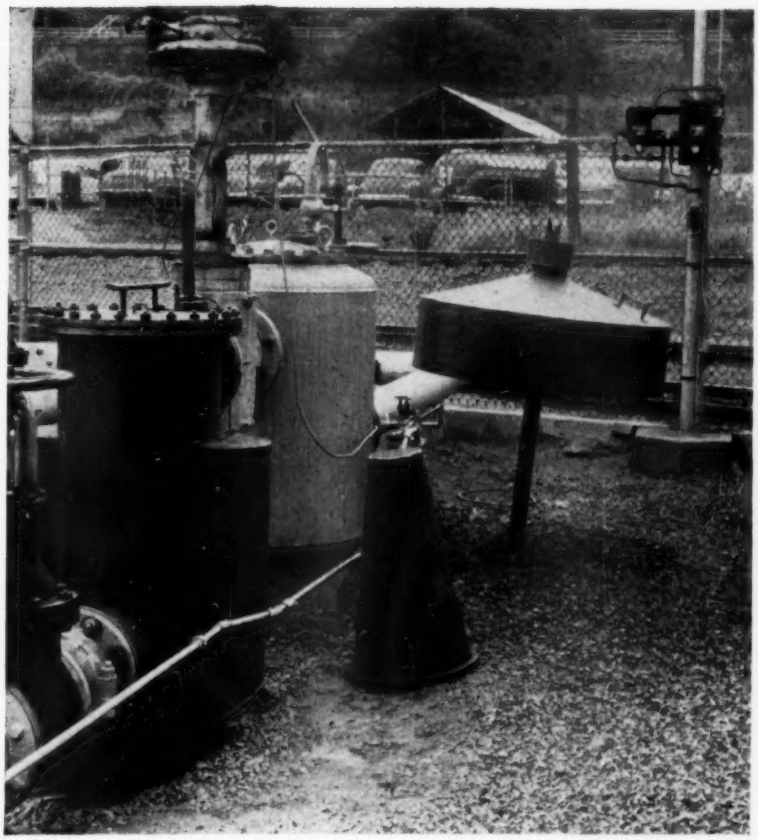
This simple arrangement has practically eliminated strainer replacement. And the cost of the installation is so small that it is more than repaid every time the *Pressuretrol* saves a strainer.

Honeywell Differential Pressure Controller

Safeguarding pressures is but one of the many uses you can find for the more than 7000 different Honeywell control devices. Each of these is thoroughly dependable, well proved by industrial service . . . and all are backed by Honeywell's nationwide service organization.

WOULD YOU LIKE TO RECEIVE "Industrial Control News"?

You'll find a wealth of ideas on how to use automatic control devices in *Industrial Control News*. If you're not already receiving this informative magazine, just send your name, company, title and address to MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Station 213, 4491 Wayne Ave., Philadelphia 44, Pa.



Strainer damage ended by Honeywell pressure controller

General Petroleum Corporation needed an economical way to prevent the recurring damage to big, costly strainers in their Portland, Oregon terminal. A Honeywell Differential *Pressuretrol* does the trick economically—automatically warns operators when scale begins to clog the strainer, so they can replace before damage occurs.

Literally thousands of plant operations and products can be made safer, improved, simplified, or rendered more automatic . . . through the use of Honeywell devices for controlling temperature, pressure, liquid level, vacuum and humidity. Your local Honeywell sales engineer will be glad to discuss your own applications . . . and he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, 4491 Wayne Ave., Philadelphia 44, Pa.

● **REFERENCE DATA:** Write for Catalog 8305, "Industrial Controls."

MINNEAPOLIS **Honeywell**

First in Controls

For more facts circle 571 on Reply Card

THE FACTS OF

LIGHT

...AND THOMPSON METAL POLE UNITS

FACT NO. 1: Modern park-site type plants are designed for appearance as well as efficiency. In keeping with this trend, THOMPSON now offers an exclusive new Metal Pole Unit that features streamlined beauty and assures peak lighting efficiency at all times.

FACT NO. 2: Only THOMPSON Metal Pole Units incorporate a patented disconnecting and lowering mechanism that permits rapid . . . safe . . . efficient ground-level luminaire servicing by one man.

FACT NO. 3: THOMPSON Metal Pole Units eliminate all maintenance hazards. No ladders, scaffolding or lifts are needed for luminaire servicing . . . luminaires can be quickly lowered, relamped and cleaned, and then repositioned from the ground. Electrical dangers are eliminated because lowered fixtures are 'dead'.

FACT NO. 4: THOMPSON Metal Pole Units facilitate low-cost maintenance by saving man hours . . . reducing accidents. Pole-mounted luminaires now can be serviced at a fraction of normal time and cost.

THE THOMPSON ELECTRIC CO.

1165 POWER AVENUE • CLEVELAND 14, OHIO

For more facts circle 572 on Reply Card

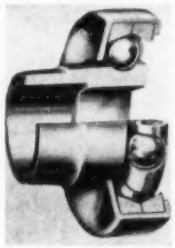
NEW PRODUCTS

(Begins on page 110)

tiered approximately six feet without buckling, says manufacturer, depending on the weight of the parts. Charles William Doepke Mfg. Co.

15—BALL BEARING designed for conveyor roll use

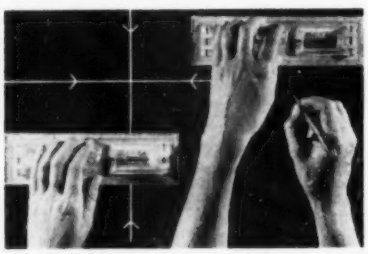
Non-friction bearings in this manufacturer's new X series are patterned after a design usually found only in expensive precision bearings, it is announced, yet their cost is about the same as older-type conveyor bearings. In the new type of bearing, the balls are separated with a one-piece retainer which requires no rivets to hold its parts together. It is interchangeable with company's older type bearings and has the same capacity. With less friction it operates by gravity on ⅓ less grade than the older bearing, company says, and it is quieter. Logan Co.



16—DRAWING INSTRUMENT leaves one hand free

A versatile new transparent instrument, the Glide-Rule rolls in two directions. It is designed to combine several engineer's tools in one — triangles, T-square, straight edge, scales, protractor, and parallel rules—to serve as a "pocket-portable" drafting machine. Only 2½ by 9 in., the instrument has four drawing edges with scales in 16ths and 20ths. The protractor has emphasized 30-, 45- and 60-deg angles.

The operation of the Glide-Rule leaves one hand free for drawing. The



instrument rolls both up and down and right and left. A small thumb button lets the user change direction and roll the rule to the desired position. A professional model of the Glide-Rule sells for less than $4.00, a student model for less than $3.00. Smith Drake Corp.

17—ELECTRODE uses the arc heat more efficiently

Jetweld incorporates powdered metal into the electrode coating. This new type of coating is said to use the heat of the arc more efficiently to achieve

Black & Decker
Cases for Comment

MAINTENANCE

(Case History 2117)
B&D Bench Grinders often give more than 10 years constant use...not losing a minute for repairs.

CONSTRUCTION

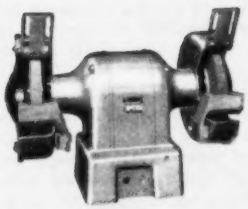
(Case History 4881)
Workers on heavy construction project report B&D Portable Electric Grinders... stand up very well, very handy to use, not awkward nor heavy, give no vibration.

PRODUCTION

(Case History 4092)
This B&D Die Grinder cuts grinding time ⅓ ...does twice the work.

The McDonald Company of Boston, Mass. manufactures galvanized iron and stainless steal equipment. B&D Tools used for approx. 8 years. In addition to Die Grinder they use B&D Shears, Holguns* and Portable Electric Grinders. The Black & Decker Die Grinders have cut the job time by at least ½. Company reports amount of work doubled.

Joe, plant management says that B+D Tools "can take it"
Top management says, "could use more of them"



BENCH GRINDERS
Heavy-Duty models available in 3 sizes, 6", 8", 10". For the finest tool dressing, grinding, wire brushing, burnishing, buffing.

PORTABLE ELECTRIC GRINDERS
In 3 models, 3", 5", 6". All with husky housings and precision parts. Ideal for any job where grinder must be taken to the work.

DIE GRINDERS
2 models. The No. 8 is powered by a new B&D-built motor. Small, only 2½ lbs... compact, diameter only 2⅛". Also available, 3" Die Grinder.

See "TOOLS-ELECTRIC"

* Trade Mark Reg. U. S. Pat. Off.

Here's Proof that Black & Decker Power Saves *Time and Trouble*

In countless cases where industry needs power, industry's choice is Black & Decker.

In grinders, drills, saws, hammers, screw drivers, industry finds Black & Decker packs the power to get greater production... per machine... per man-hour.

Why? Because Black & Decker Power is *custom-built* into every B&D Tool... power to perform the job the tool is specially designed to do. B&D Tools are driven by B&D-built motors. Built with precision parts and husky housings (in the most advanced designs) every B&D Portable Electric Tool can be relied upon to give long service with less trouble. Every one is a profit-making production tool. And the facts prove it.

Find out for yourself. Next time the job calls for power, call on Black & Decker to supply it. Call your B&D Distributor for a demonstration. And write for free detailed catalog. Address: THE BLACK & DECKER MFG. CO., 611 Pennsylvania Ave., Towson 4, Md.

LEADING DISTRIBUTORS EVERYWHERE SELL

B&D Black & Decker
PORTABLE ELECTRIC TOOLS

For more facts circle 573 on Reply Card

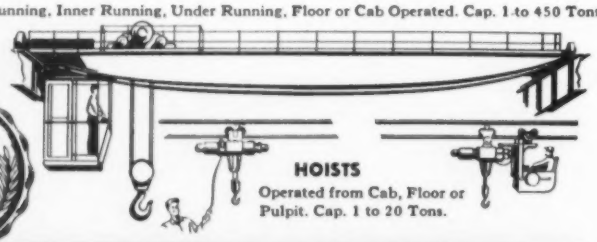
SHEPARD NILES CRANE

adds "Wings" to your work-in-process

Watch the way work speeds up when you install a Shepard Niles Crane in your plant! Why? Because through-the-air handling frees manpower for production—speeds the flow of materials—makes more floor space for men and machines. With a Shepard Niles Crane, you put unused ceilings to work—handle heaviest loads safely, easily, at low cost.

No doubt your plant would benefit from thrifty through-the-air handling. But which type of crane should you choose? Let the Shepard Niles representative help you in making this decision—he knows the importance of installing the right equipment from the start. Send for Bulletin describing Shepard Niles Cranes today—and arrange to have a representative stop by your office.

CRANES
Overhead: Top Running, Inner Running, Under Running, Floor or Cab Operated. Cap. 1 to 450 Tons.



50th ANNIVERSARY
SHEPARD NILES CRANE & HOIST CORP.
1903-1953

HOISTS
Operated from Cab, Floor or Pulpit. Cap. 1 to 20 Tons.

SHEPARD NILES
CRANE AND HOIST CORPORATION

2232 SCHUYLER AVENUE, MONTOUR FALLS, N.Y.
For more facts circle 574 on Reply Card

NEW PRODUCTS

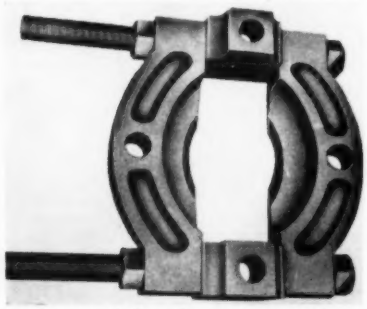
(Begins on page 110)

the fastest of hand welding speeds with higher standards of weld quality, appearance and ease of operation. A heavily coated shielded-arc type of electrode for operation in flat or near-flat positions with a-c or d-c welding current, Jetweld is designed to meet physical requirements of Class E-7016 and for use on work formerly calling for E-6012 and E-6020 electrodes on single or multiple pass welds. It is said to be well suited for horizontal and flat position fillets, horizontal and flat position laps, single and multiple pass butts, deep grooves and corners, and cover pass on multiple pass butts.

According to company, the weld metal is uniform x-ray quality, free from undercut with better impact values at low temperatures than possible with many electrodes, other than low hydrogen types. Welding speeds typical in lap and fillet work are about 12 to 15 in. per min, it is pointed out. Jetweld is available in $\frac{3}{32}$-, $\frac{1}{8}$- and $\frac{1}{4}$-in. sizes. The Lincoln Electric Co.

18—PULLING ATTACHMENTS come in large sizes

Two large-size pulling attachments for use with standard pullers are announced. When used with manufacturer's 50-ton Power Twin Hydraulic Ram in connection with either Grip-o-matic Pullers or Push-Pullers, these attachments are said to facilitate removal and installation of large bearings, gears, pulleys, sheaves, wheels and couplings on all types of machinery. One size has a capacity from $5\frac{3}{4}$



to 13 in., and the other, a capacity from $6\frac{3}{4}$ to 16 in. The pulling tees into which Push-Puller legs are threaded, more evenly distribute the load when extreme pressure is used, it is explained, and greatly reduce the danger of distortion. Owatonna Tool Co.

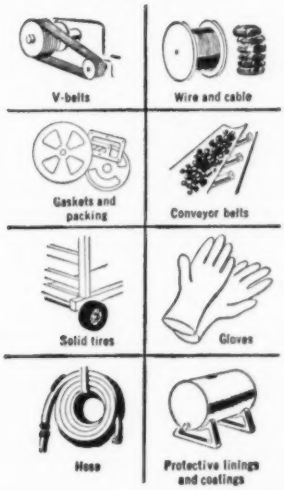
19—CASTER STEER TRAILER offers increased safety

This new controlled caster-steer trailer, of 8000-lb capacity, is suggested for handling heavy, high center of gravity loads. The caster-steering feature is designed to minimize tipping hazards and the long wheel base and wide tire treads provide additional stability. Steering is accomplished by retractable

BETTER RUBBER PRODUCTS ARE MADE WITH DU PONT NEOPRENE

Neoprene flexible ducts boost production 10% in buffing operation . . . still on job after 2½ years

SPECIFY NEOPRENE IN THESE PRODUCTS:



A large manufacturer of automobile accessories ran into trouble on his buffing and polishing line operation. Rust and dirt caused metal exhaust ducts, integral with the buffing wheels, to stiffen within six months, and positioning of the wheels became a major, time-consuming operation. The problem called for a new type of duct, and Du Pont neoprene supplied the answer.

By installing flexible neoprene-coated fabric ducts, this firm cut adjustment time from hours to minutes . . . increased production 10% in the buffing department, and cut consumption of buffing wheels by 15%. Moreover, despite constant exposure to abrasive grit, grease and buffing oils, the neoprene ducts are still in good condition after *2½ years of service.*

This service record is a typical example of how many neoprene products reduce maintenance costs and improve production. While Du Pont makes no finished goods of neoprene, your manufacturer or distributor will be glad to tell you about the neoprene products he supplies.

DU PONT
REG. U. S. PAT. OFF.

BETTER THINGS FOR BETTER LIVING . . . *THROUGH CHEMISTRY*

NEOPRENE

The Rubber Made by Du Pont Since 1932

MAIL THIS COUPON TODAY

FREE! THE NEOPRENE NOTEBOOK—Every issue describes new products, unusual applications of neoprene . . . shows how neoprene cuts maintenance costs. Clip and mail this coupon to get on the mailing list. E. I. du Pont de Nemours & Co. (Inc.), Rubber Chemicals Division PL12, Wilmington 98, Delaware.

Name_____ Position_____

Firm_____

Address_____

City_____ State_____

For more facts circle 575 on Reply Card

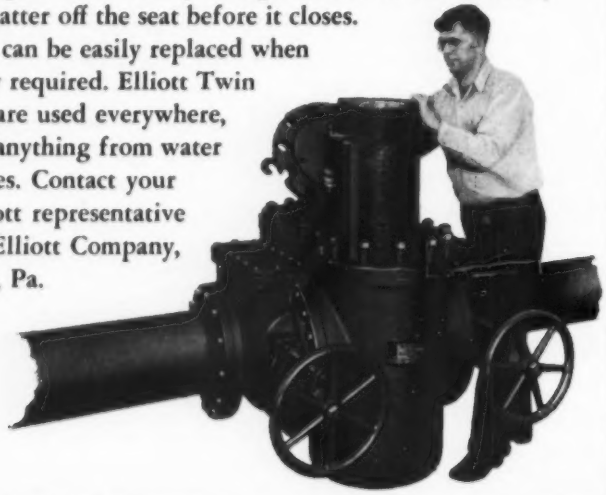
There's no "do it now" about cleaning an

ELLIOTT TWIN STRAINER

No need to interrupt some vital maintenance job to dump the fouled basket on one of these non-stop straining units. The alternate basket will take on the job with the turn of a couple of handwheels, cutting out the fouled basket for attention any convenient time within a reasonable period.

Not that cleaning is so much a job. It isn't—all that's necessary is to back off the cover nuts a few turns, spin out the washers, lift the cover, pull out the basket, dump it, and reverse the process. That basket is open at the top, too, for easy dumping. No fussing to get out the trapped trash.

TWIN STRAINERS have a number of features to help them keep on the job. Valve discs, for instance, have an inserted rubber ring as wear-worthy as a good tire, that brushes any foreign matter off the seat before it closes. This ring can be easily replaced when ultimately required. Elliott Twin Strainers are used everywhere, handling anything from water to molasses. Contact your local Elliott representative or write Elliott Company, Jeannette, Pa.



ELLIOTT Company

Accessories Dept.

A3-2

For more facts circle 576 on Reply Card

NEW PRODUCTS

(Begins on page 110)

tubular loop-handle connected by tie rod linkage between hitch and caster assembly. "C" type couplers on the rear permit use of this trailer in a trackless train system.

The trailer is 24 in. high, 3 ft wide, and 8 ft long. Steel frame members support the hardwood deck and all wheels are equipped with solid pressed-on rubber tires, and mounted on Hyatt roller bearings. Side boards are optional. Mercury Mfg. Co.

It's easy to obtain product data with the postage-free Reader Service Cards on pages 35-36 and 149-150. Use them for information on advertised products, too. Just circle the key number appearing at bottom of the ad.

20—BINDING KITS for loose-leaf records, sheets

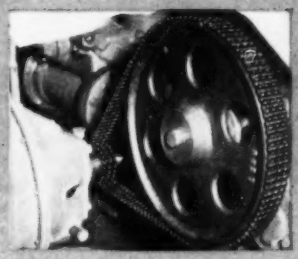
Three- and four-punch plastic binding kits are announced as offering the attractiveness and loose-leaf convenience of plastic binding at unusually low cost. The kits include a punching machine which punches approximately 15 sheets at a time, depending on thickness, and 150 plastic tubes. Additional

tubes are available, too. The tubes are easily inserted by hand, and they provide a neat, good-looking binding for inventory sheets, records and other data. The three-punch kit sells for less than $17.00, the four-punch one for less than $30.00. A two-punch kit, previously introduced, is also available. Tauber Plastics, Inc.

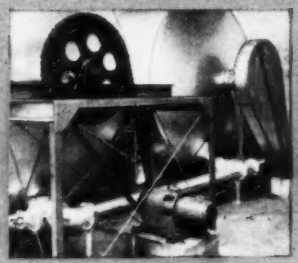
21—EMULSION-TYPE ENAMEL is for use on metals

This product is designed for application on metals, and is an emulsion type enamel in which water is employed both as an ingredient and a reducing agent. Although water-reducible in the application process, it is not water-soluble after application and has good oil resistance. Its glossy finish has high impact resistance. Company says that in the liquid state, the finishing material will not ignite at normal room or

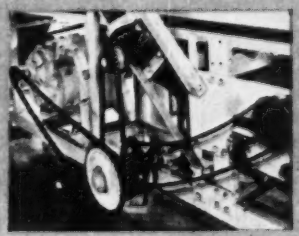
Meet Drive Problems WITH DIAMOND ROLLER CHAINS



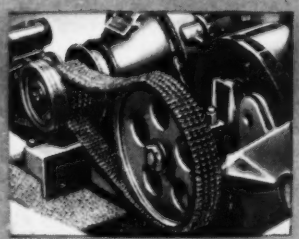
Here is a short motor to shaft drive—high speed Diamond triple-strand Roller Chain.



Here is a drive where shaft centers are far apart.



Here is a one shaft to several shafts Diamond Roller Chain application.



An example of widely used internal combustion engine to main shaft drive.

• Shafts can be placed where most convenient and economical, and power transferred from the power source or from one shaft to another with maximum efficiency.

◆

Weight is reduced—Diamond Roller Chains are light in relation to power transmission capacities and tensile strength.

◆

Maintained efficiency 98-99%.

◆

Installation and/or replacement costs are low.

◆

Speed changes can be altered by replacement of a sprocket.

◆

Non-slipping operation is assured—Diamond Roller Chain Drives are as positive as gears.

◆

There is no right or wrong side.

◆

Obstructions can be by-passed economically.

◆

Suitable for conveyor drives with standard and special chains.

And the *uniform* high quality of every foot of Diamond Chain plus the in-built reserve strength and inherent elasticity have provided the superior performance and long-life dependability that mean machinery operation at its best.

DIAMOND CHAIN COMPANY, Inc.

Where High Quality is Traditional

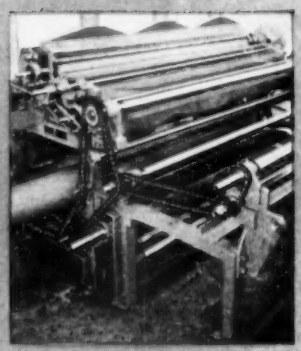
Dept. 614, 402 Kentucky Ave., Indianapolis 7, Indiana

Offices and Distributors in All Principal Cities

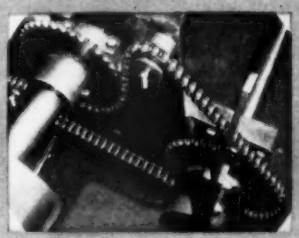
Refer to the classified section of your local telephone directory under the heading CHAINS or CHAINS-ROLLER

DIAMOND **ROLLER CHAINS**

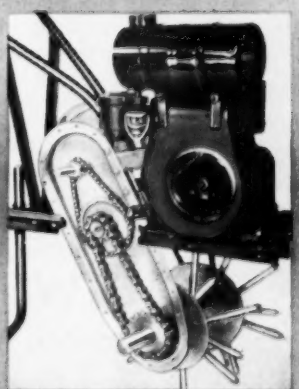
Shot-Peened Since 1946



What other means could be used than shown by this Diamond Roller Chain application?



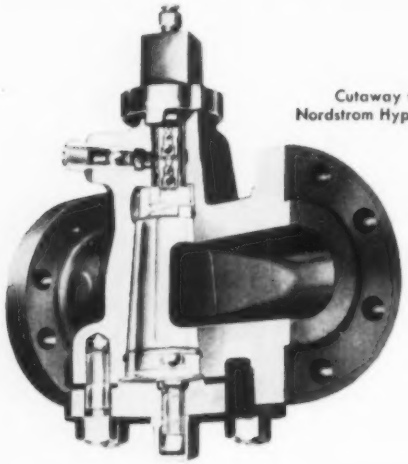
A simple means of operating two shafts in opposite directions.



Simple means of reducing.

For more facts circle 577 on Reply Card

How much should you spend for valve maintenance?



Cutaway view of Nordstrom Hypreseal valve

In all but the most simple services, *any* kind of valves need *some* maintenance.

Of course the same thing is true with any mechanism where metal rubs metal. Take your car, for example. You lubricate the engine to *reduce* maintenance and save major repair bills. If you don't lubricate it, you save a few dollars on lubricant, but pay the far, far higher costs of part replacement. More important, you'll need a new car much oftener.

Exactly the same principle applies to valves. If you install Nordstrom lubricant-sealed valves, maintenance is generally confined to adding lubricant at intervals. You lubricate to *reduce* maintenance—to avoid the high costs of major repairs, new parts, and shorter valve life. That's the big advantage of Nordstrom valves in the first place.

Over a 20-year period, Nordstrom sales of repair parts have been less than half of one per cent of sales. In several plants in which records were kept and where Nordstrom and other valves were used, repair parts for Nordstrom valves ran about one-tenth of other makes.

LUBRICANT SEALS AND SAVES

Lubricant has several functions in a Nordstrom valve, but there are two major ones . . .

First, it *seals*, surrounding the valve ports with a coating that stops little leaks before they become big problems.

Second, it *lubricates* so the plug slides without the grinding, galling wear that means high replacement costs.

So, don't be misled . . .

Valve lubrication doesn't *cost* money, it *saves* money. If you'd like to discuss the application of Nordstrom valves for any service, call your Nordstrom representative or write Rockwell Manufacturing Company, Pittsburgh 8, Pa.

Canadian Licensee: Peacock Brothers Limited

ROCKWELL Built
Nordstrom Valves
Lubricant-Sealed for Positive Shut-Off

Another Product

For more facts circle 578 on Reply Card

NEW PRODUCTS

(Begins on page 110)

operating temperatures; after application and drying, the finish becomes combustible to a limited degree.

Features announced for this emulsion enamel are: It is formulated either for dip or spray application; its hardness, adhesion properties and resistance to oil film are good; industrial units already coated with the enamel can be machined or fabricated without damage to either the finish or the cutting tools. General Industrial Div., The Sherwin-Williams Co.

22—HANDLING UNIT moves big loads in tight spots

Offered as a means of handling heavy loads in confined areas where usual equipment is not feasible or economical, the Tug Bar weighs only 110 lb, can be operated by one man, and moves loads in excess of 2 tons, says its manufacturer. Small enough to be operated wherever there is room for a man to stand, the Tug Bar is pictured

moving an aircraft jet engine tank to the forward section of a cargo plane.

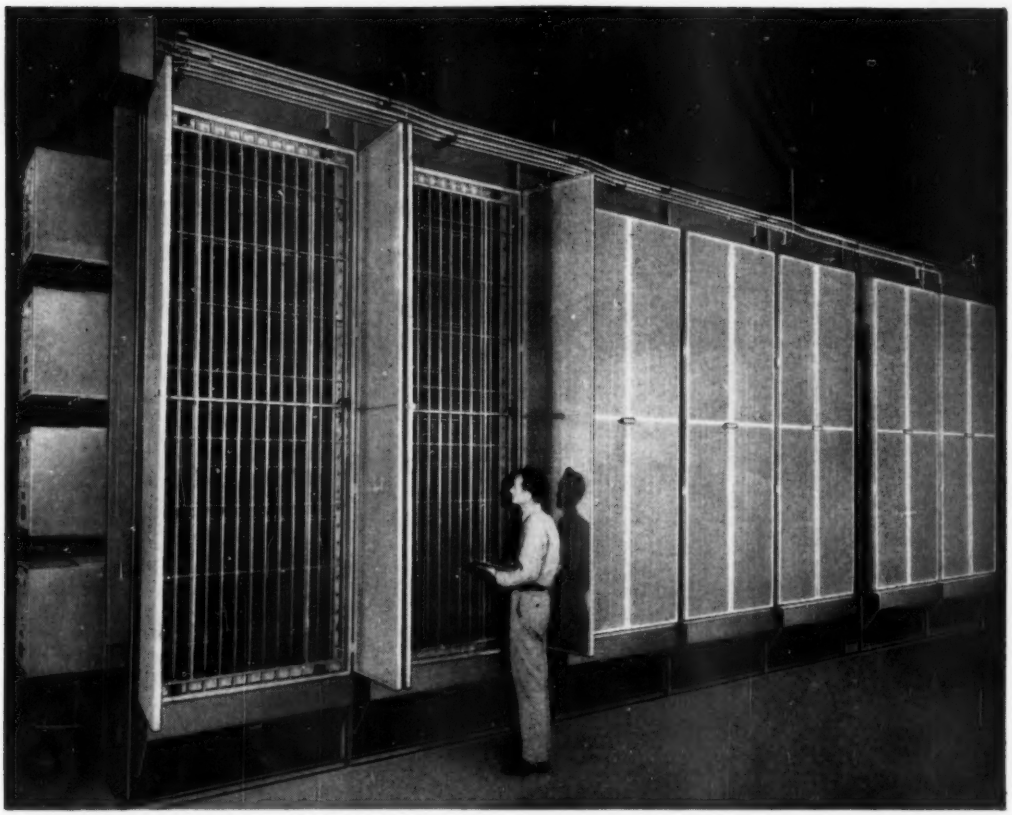
Basically, the Tug Bar is the application of motive power through a gear box on a micro-lever bar, it is explained. The unit comprises a reduction gear powered by either a-c or d-c type motor and mounted on wide driving wheels. Operating controls are brought out to the adjustable handle. Western Gear Works.

23—MAGNETIC PULLEY is small sized but strong

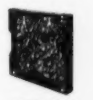
Reported to test as strong as units twice its size, this 4-in. diameter permanent magnetic pulley utilizes a peripheral magnetic field running completely around the pulley surface parallel and circumferentially to the shaft. It is announced as an ideal magnetic separator for conveying systems where belt thicknesses are $\frac{1}{8}$ in. or less and speeds do not exceed 30 rpm. It is also suggested as a sheet steel feeder or controlling roll.

The non-electric pulley is built in nine belt widths from 4 to 24 in. Because of the proximity of the magnet

a single source for all air cleaning equipment



** AAF's ELECTRO-MATIC—Introduced by American Air Filter in 1939, the automatic self-cleaning ELECTRO-MATIC incorporates the most advanced application of the electronic principle of air cleaning. Automatic operation assures constant, uniform performance—a vital factor in air conditioning and many critical industrial processes. American Air Filter manufactures four other electronic precipitators which utilize every known method of maintenance.*



Why five types of electronic* air cleaners?

AAF's five types of electronic precipitators have highly individual characteristics . . . for a reason! They were developed to meet complex and distinctly different air cleaning requirements for fine particle size in commercial, industrial and domestic applications.

These five types offer the engineer maximum flexibility in combining the following factors to fit specific job requirements:

- Efficiency Ratios
- Maintenance Methods
- Space Requirements
- Sizes and Air Volumes
- Practical and Realistic Range of Costs

In addition to a complete line of air cleaning equipment, AAF offers a nationwide engineering service, which is outstanding in this field. On all air cleaning problems call your AAF representative for expert advice, or write direct to us for engineering data and bulletins.

American Air Filter
COMPANY, INC.
228 Central Avenue, Louisville 8, Kentucky
American Air Filter of Canada, Ltd., Montreal, P. Q. • Pacific Division Office, San Francisco, California

AAF

For more facts circle 579 on Reply Card

accurate instrumentation need not be costly

here's proof . . . Accurate to ± 1% of full scale, this Fielden TEKTOLOG Electronic Recorder has a sensitivity of ± 0.1% and reproducibility of ± 0.5%. Yet it sells at a price substantially below that of servo-operated potentiometer-type recorders!

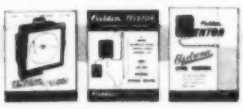
Reason: *Simplified* design, circuitry and construction. TEKTOLOG's recorder mechanism consists of only 4 principal units. By stressing *simplicity*, Fielden can bring you *all the accuracy you need* for most applications—without extra charges for marginal precision.

If simplified, practical instrumentation appeals to you, write us today for full details. There's no obligation.

DOLLAR FOR DOLLAR—YOUR BEST INSTRUMENT VALUE

Fielden

INSTRUMENT DIVISION



ROBERTSHAW-FULTON CONTROLS COMPANY
2920 N. 4th St., Dept. C, Philadelphia 33, Pa.

Send full details of Fielden simplified ☐ TEKTOLOG Electronic Recorders
☐ TELSTOR Electronic Level Indicator ☐ TEKTOR Electronic Level Control

*Name*_____

*Title*_____

*Company*_____

*Address*_____ *City*_____ *State*_____

Fielden TEKTOR Electronic Level Control

Fielden TELSTOR Electronic Level Indicator

For more facts circle 580 on Reply Card

NEW PRODUCTS

(Begins on page 110)

castings and pole plates to the shaft, these pulleys are furnished with heavy non-magnetic, 1-in. stainless steel shafts. The pulleys themselves can be supplied in stainless steel. Standard construction is a flat-faced pulley. When a crown is required, the user can wrap a strip of aluminum around the center of the pulley to control the belt. Eriez Mfg. Co.

24—ACID HOSE resists wide range of solutions

Condor Acid Discharge and Condor Acid Suction Hose are announced as highly resistant to a wider range of acids, salts, alkalies and other solutions. According to manufacturer, the improvement was made by compounding a new synthetic with other acid-resisting materials for tube and cover. The improved hose is said to withstand many organic and inorganic acids, salts and alkalies and plating solutions much longer than many types of acid hose and to be suitable for conveying solutions previously not recommended for rubber hose. The tube of this hose is also claimed to be abrasive resistant to withstand slurries. Manhattan Rubber Div., Raybestos-Manhattan, Inc.

25—FACING TILE for constructing single unit walls

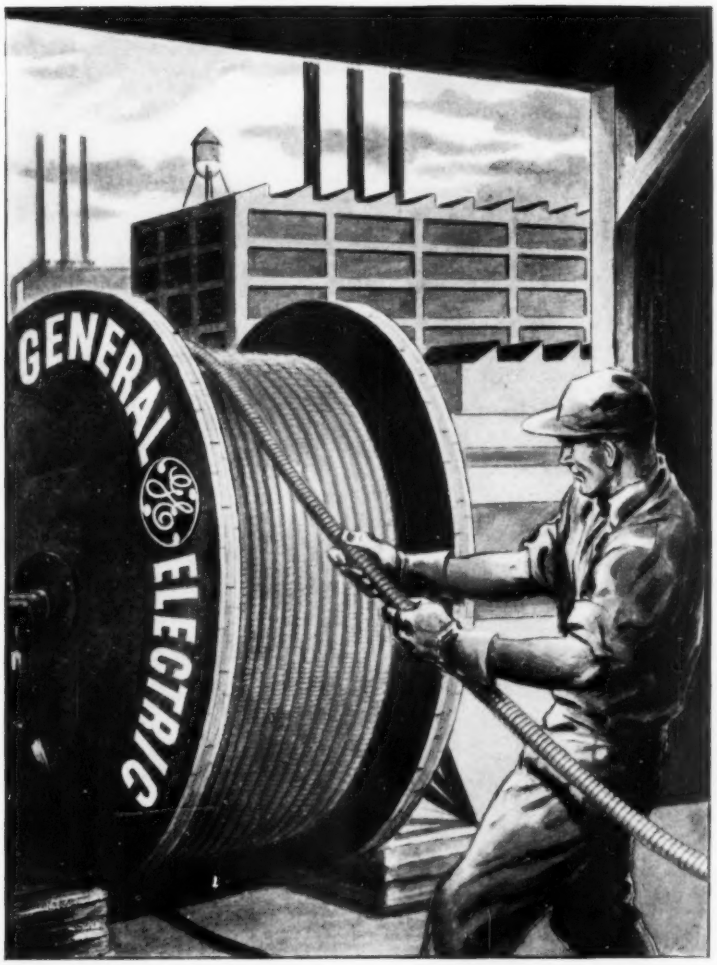
Uniwall is a new line of load-bearing facing tile developed to make possible single-unit wall construction with finished facing inside and out. The interior surface is ceramic glazed and the exterior finish is natural Buff Range Unglazed Rug-Tex. Uniwall units are made with a jamb slot to receive the "fin" of a metal window or the blind stop extension of a wood window. Interior ceramic glazed shapes are available to supplement standard units.

Modular dimensions apply to all unit sizes but they are declared equally adaptable for non-modular construction. With allowance for ⅜-in. mortar joints, the nominal dimensions of Uniwall are: wall thickness 8 in. and face size 4 by 12 in., with corner and jamb units of corresponding dimensions. The tile is of vertical cell construction, of hard-burned deaired fire clay. Construction details are given in Technical Bulletin UW 100. Natco Corp.

26—TRIANGULAR RACKS for improved coil handling

Both economy and engineering advantages are said to characterize this triangular coil rack. Its three-point suspension permits more stable stacking, company says, and it can be picked up from any angle, affords six-way entry, and can be stacked and moved with fork lift truck, hand pallet truck or overhead hoist. When equipped with casters or set on a dolly it can be moved manually. With a wood or steel rectangular or square deck it can be

When you need a cable system in a hurry—



G-E V-C INTERLOCKED ARMOR CABLE SYSTEM cuts both time and cost

Installation Time Reduced

If you're building or modernizing a plant, and production can't wait, use a General Electric V-c interlocked armor cable system for primary and secondary power distribution. It can be installed fast, indoors or outdoors, around corners, over beams, in long runs down the production lines. The cable is installed on low-cost aluminum racks hung from the ceiling, and spliced with simple mechanical joints. Engineering, as well as installation time, is cut; production can start much sooner than would otherwise be possible.

Wiring Costs Reduced

The cost table at the right will show you another good reason for using G-E armored cable. Installed costs of secondary feeders are 24% lower than those of the next most economical system. Add to this the future cost savings due to the adaptability of an armored cable system. Each circuit is a separate cable that can be moved or spliced easily when load requirements change.

For further information on this quickly and economically installed cable system, consult your G-E cable specialist, or write Section W114-1264, Construction Materials Division, General Electric Company, Bridgeport 2, Connecticut.

COMPARISON OF MATERIAL COSTS
for plant distribution systems (Rated capacity 2000 amperes at 480 volts)

Carrier	Estimated cost per 100 feet
Varnished cambric interlocked armor cable system including racks*	$3000
Varnished cambric and braid in steel conduit	$3966
Type RH rubber insulation in steel conduit	$4660
Aerated bus-way	$4976

*Figures based on steel racks. Aluminum racks are normally used because they are lighter and easier to handle.

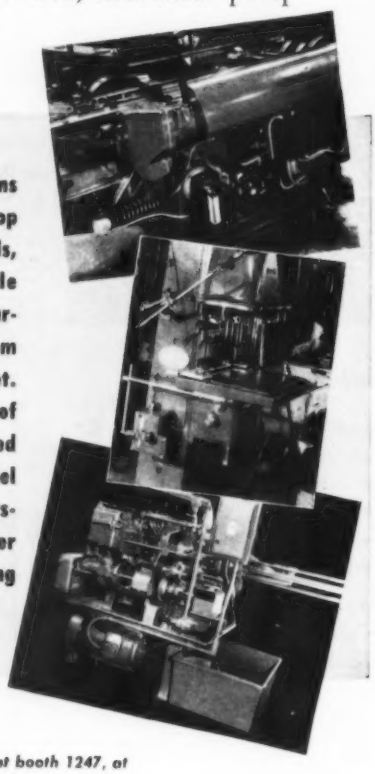
You can put your confidence in—

GENERAL ELECTRIC

For more facts circle 581 on Reply Card

Now PULSOLATOR is made and sold by Manzel

Manzel has added the world-famed *Pulsolator* to its established line of Force Feed Lubricators and Chemical Feeders. Thus, this 55 year old organization now offers low pressure, single pump lubrication for applications where the unlimited pressure of Manzel force feed, individual pump systems is not required.



Here are three typical applications showing *Pulsolator* automatic, loop systems for lubricating machine tools, printing presses and comparable equipment. As many as 1,000 bearings can be lubricated by one system from a loop line of up to 300 feet. Capacities, timing, and quantity of lubricant delivered can be adapted to individual requirements. Manzel engineers will be glad to plan a system to meet your exact needs either on new machines you are planning or on existing equipment.

Manzel

See us at booth 1247, at Plant Maintenance Show.

DIVISION OF FRONTIER INDUSTRIES
301 BABCOCK STREET, BUFFALO 10, NEW YORK

For more facts circle 582 on Reply Card

NEW PRODUCTS

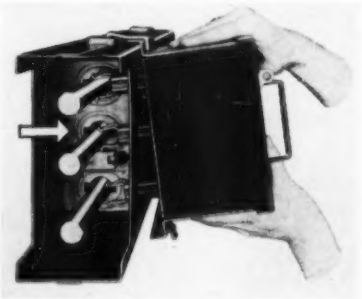
(Begins on page 110)

converted into a standard rack for storing small, irregular shaped parts.

There are no standard sizes or load capacities—this new triangular coil rack is designed, and produced to user's requirements. It is equipped with company's "nesting pyramids" for safe, easy and economical stacking. A "spec" sheet indicating measurements for any individual requirements is available. The Paltier Corp.

27—BUS BAR INSULATOR withstands high short circuits

Ability to withstand exceptionally high short circuit stresses is claimed for this new bus bar insulator and support. Made of a one-piece non-carbonizing cold-molded material, this support is used throughout company's line of Plug-in Duct. Tests are reported to show that in the 225-, 400- and 600-



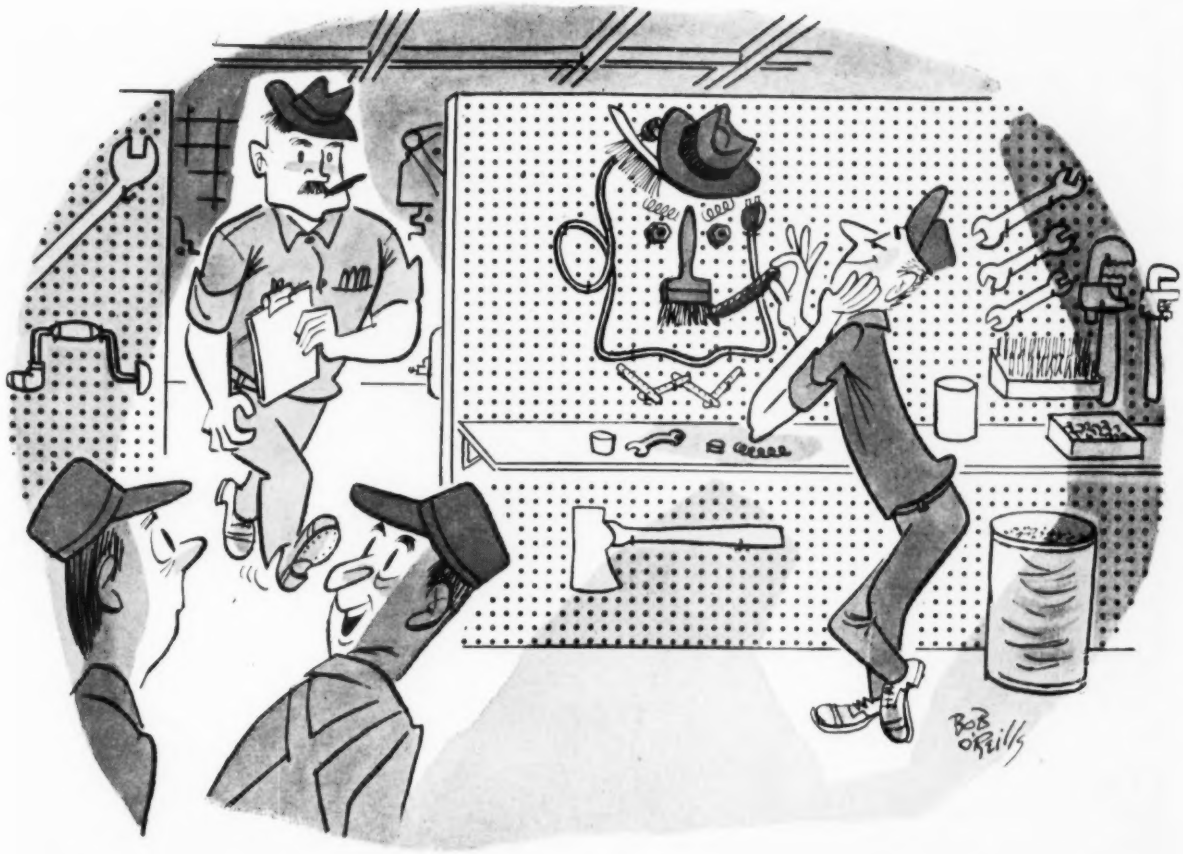
amp ratings, where one round bus bar per phase is used, the insulator can withstand short circuit stresses produced by currents in excess of 25,000 amp; and in the 800- and 1000-amp ratings, using two round bus bars per phase, the short circuit can be in excess of 50,000 amp without damage.

Other features announced for this insulator include versatility of mounting for either vertical riser or horizontal installations, and high mechanical and dielectric strength. The insulator is designed to utilize the flexible joint connections between Plug-in Duct lengths and identical joint ends. Square D Co.

28—COMPRESSORS feature sectionalized cylinders

Gas and air compressors in the new Class ATH line employ sectionalized cylinders arranged in three pieces, and with inlet and discharge valves in the fronthead and backhead. Cylinder liners are standard equipment. Several advantages are attributed to this design. Since the cylinder is sectionalized and readily disassembled, the liner may be removed without disconnecting inlet or discharge air piping. Service problems involving piston rings, piston or liner are minor operations, says manufacturer; and the cooling water passages may be thoroughly cleaned, since these passages are accessible.

Also, the valves in the heads feature



"I always said you could hang anything on Masonite Peg-Board!"

Anything from a slip of paper to a riveting hammer.

It's easy to hang all kinds of tools, equipment and supplies on walls and partitions made of tough, sturdy Masonite Peg-Board* panels. ⅛" thickness for normal use; ¼" for heavy-duty work.

Thousands of clean-cut holes, one inch apart, allow almost endless arrangements—and re-arrangements as needs change. Metal fixtures—more than 60 different varieties lock on without nails or screws. A twist of the wrist removes them.

See the building materials dealer in your area for the panels and the exact fixtures you need. Made of all-wood hardboard, they're part of the versatile family of Masonite Presdwood® Products—now helping plant men in thousands of ways. Send the coupon for the complete story.

all through the plant...

MASONITE PRESDWOOD

solves maintenance problems!

BETTER HARDBOARDS FOR BETTER MAINTENANCE

*"Peg-Board" Reg. T.M. U.S. Pat. Off. B.B. Butler Mfg. Co., Inc.

MASONITE® CORPORATION

Dept. PE-12, Box 777, Chicago 90, Ill.

Please send me your folder on Masonite Peg-Board Panels and your brochure on "How to Improve Factory Methods with Masonite Presdwood."

Name.....

Firm.....

Street.....

City.....*Zone*.....

County.....*State*.....

"Masonite" signifies that Masonite Corporation is the source of the product

For more facts circle 583 on Reply Card

AVAILABLE—

A COMPLETELY NEW CONCEPT IN CONTROL VALVE DESIGN...

BODY RATING TO
50,000 PSI
FLOW RANGEABILITY
C_V .000001 TO 0.1

1 Substantial forged alloy (wide selection) valve body.

2 Rugged all stellite, easily removable, Pin-Mite valve seat.

3 Direct positive seal, inlet tubing to valve seat connection.

4 Hard chrome-plated, super finished valve stem with stellite plug.

5 Annin "Super VO" stem seal assembly.

6 Thumbnut valve stem locking unit.

7 Powerful, lifetime lubricated, cross head and drive rod assembly.

8 Simplified combination stroke and valve action adjusting unit.

9 Direct and reverse acting stem stroke adjusting scale.

10 Needle bearing mounted motion converter arm.

11 Cross head pre-loading spring, eliminating lost motion.

12 Exclusive, extra strong, box type frame unit.

And now — Annin's "Wee Willie" — new in concept and design, providing the Research and Development engineer with a pilot plant instrument having a water Cv range from .000001 to 0.1 with control of pressures to 50,000 PSI. Unique design minimizes distortion, stretching, and friction. The time-proven Series "A" Domotor power unit provides precise and positive control under all conditions. "Wee Willie" may be the answer to your problems in the high pressure field. Investigate this new valve today!

"Wee Willie"
DOMOTOR
VALVES

Write today for bulletin No. 50WW for complete information and engineering data on "Wee Willie"

ANNIN
Control VALVES

THE ANNIN COMPANY
4570 E. TELEGRAPH ROAD, DEPT. A123
LOS ANGELES 22, CALIFORNIA

For more facts circle 584 on Reply Card

NEW PRODUCTS

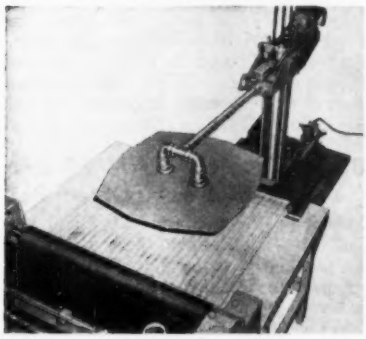
(Begins on page 110)

of this construction allows better cooling, it is explained, and provides lower temperature through the cylinder and valves. Cooling jackets adjacent to the cylinder heads are generous in size, of importance because the maximum temperature rise occurs at the end of the stroke adjacent to the cylinder heads. And, besides providing increased cooling surface where needed, this design provides cross-flow of cooling water—it is admitted on the lower side of one head and discharges from the upper side of the other. Class ATH Compressors are available in single stage 100 psig discharge pressure sizes. Pennsylvania Pump & Compressor Co.

29—VACUUM LIFT handles non-porous metal sheets

Designed to reduce cost by eliminating manual operations, this automatic vacuum lift contains its own vacuum plant and is shipped completely assembled, ready to hook into electric power and air line. Manufacturer says it will handle any non-porous metal sheets, from one to six per min, up to 40 in. by 40 in. in size.

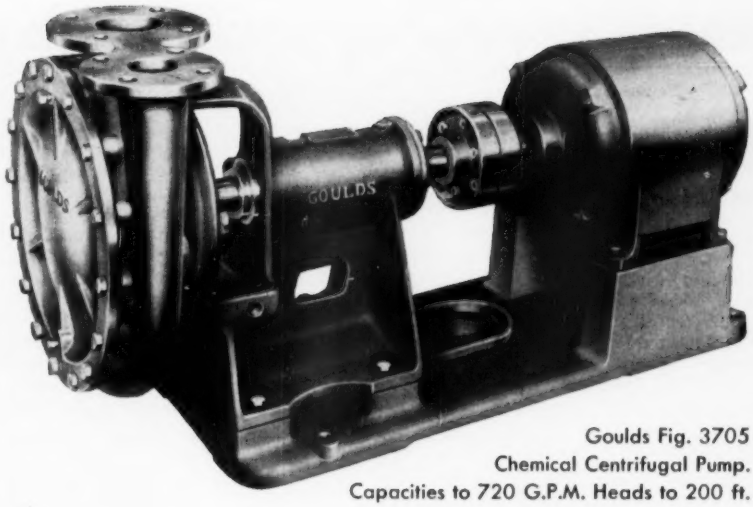
This machine, it is claimed, will pick up at any level from floor to 36 in.,



and it is adjustable through this range and through a 180-deg turn, in order to lay the sheet exactly into position in any repetitive operation. Per cycle air consumption is approximately 60 cu ft. Pushbutton control can be put on a separate unit handy to the operator, and automatic cycle can be provided. Union Tool Corp.

30—ALUMINUM PAINT for high heat metal surfaces

You can aluminum plate high heat metal surfaces with a one-brush coating of this fast-drying aluminum paint, it is announced. It is designed to withstand temperatures up to 1200 F without discoloring or blistering, and is suggested for use on burners, stoves, hot pipes, ovens and radiators. According to manufacturer, this hard-wearing paint contains fine aluminum and a chemical binder; it defies heat because the finish actually fuses with the metal as temperatures are increased. Ready-mixed, it can be brushed or sprayed on



Goulds Fig. 3705
Chemical Centrifugal Pump.
Capacities to 720 G.P.M. Heads to 200 ft.

Now available in these 8 different materials!

You know the Goulds Fig. 3705 as the pump that is saving chemical plants thousands of dollars in handling corrosive liquids such as acids and alkaline liquors.

You've asked if it could be supplied in materials other than stainless steel 316 and FA-20. Here's the answer:

You can now take your choice of these eight different materials:

1. Stainless steel 316
2. Stainless steel FA-20
3. Stainless steel 304
4. All iron
5. All bronze
6. Bronze fitted
7. All iron, stainless steel trim
8. All bronze, stainless steel trim

And you can take advantage of these four saving benefits:

a. **Long packing life and freedom from leakage**—Stuffing box on suction side of impeller means pressure is limited to suction head.

b. **Easy cleaning and inspection**—Suction and discharge connections in casing permit removal of casing cover and impeller without disturbing piping.

c. **Impeller clearance adjustable for wear**—By loosening and sliding end cap along shaft you expose locking collar on outboard ball bearing, permitting you to readily adjust impeller position.

d. **Low parts inventory**—Interchangeable parts permit you to keep inventories down and prevent excessive down-time.

To get full information on these new materials, plus performance curves, specifications and dimensions, contact your nearby Goulds representative, or clip and mail the coupon for new Bulletin 725.3.

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NEW PRODUCTS

(Begins on page 110)

and it dries in 30 min., it is noted, providing a bright finish that prevents rust or peeling. Sapolin Paints Inc.

31—CHEMICAL COOLANT offers safety, efficiency

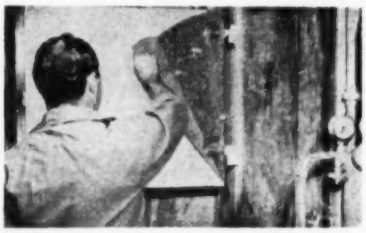
Dypral, described as a general-purpose, fire-safe chemical coolant, is said to offer increased production, improved quality control and simplified maintenance. Production advantages are claimed because it permits stepped-up speeds and feeds as well as heavier cuts, and serves to prolong tool life and eliminate need for degreasing.

Improved quality control is possible, it is explained, because pieces being machined with Dypral remain cool, permitting measurement at the machine without dimensional change later. Also, the work finish is improved, manufacturer states, and the coolant has a rust inhibiting effect on the finished parts. Since chips do not remain in suspension in Dypral, it is said to keep machines clean and prevent damage to coolant systems. Also, it doesn't gum or damage paint, company says.

Better working conditions are also attributed to this non-flammable, odorless, non-smoking coolant. Because only cool chips come from the work piece, hand and clothing burns are prevented, it is pointed out. Tests are reported to show that Dypral will not cause dermatitis. Easily used, it needs only to be mixed with water in correct proportions. West Point Mfg. Co.

32—SHIELDING MATERIAL for paint spray booths

Spray Booth Shield is a substance for protecting inner surfaces of spray booths as well as turntables and stands so that when paint overspray accumulates it may be removed quickly. Of a paste-like consistency, and milky-white in color, Spray Booth Shield can be applied by brush, trowel or knife to a thickness of about $\frac{1}{16}$ in. Since it retains its original consistency it may be used, after application, in either of two ways: It may be covered by paper —and when the paint overspray builds



up this paper can be stripped off by hand or scraper and new paper added. Or, the shielding material can be used alone; then, after the paint accumulates, both paint and shielding can be removed with scraper or putty knife. As no drying time is required, booths can be used immediately after application of this material. It comes in 5-gal cans, and in drums. Thompson & Co.

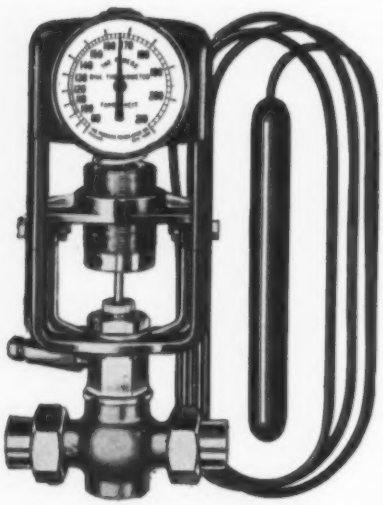
33—CONTROL VALVES are new high capacity units

Primarily designed for safety and relief valve applications, these valves are adaptable for many liquid and vapor control services by changing only the external actuating equipment. The basic valve utilizes a body design and operating principle which allows high flow capacities. The valve has angle body design and is available in 2-, 3-, 4- and 6-in. sizes for pressures from 3 oz per sq in. to 150 psi.

The valve can be opened and closed manually and automatically either at the valve or at a remote location. It can be pneumatically, hydraulically or electrically operated from a remote location. The external actuating equipment can be removed for calibration and repair or can be replaced without removing the basic valve. Controlled Flow Valve Co.

34—ALUMINUM PASTES, non-leafing, for coatings

Two types of non-leafing aluminum pastes, MD 584 and MD 784, are offered for use in protective and decorative coatings. These new pigments are announced as non-leafing, which means that although they carry a grease film, it is such that the flake will not leaf or flow when formulated in a paint. This



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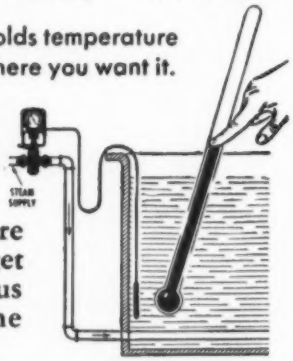

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Powers No. 11-MF Regulators are self-operating. They will help you get the most effective use from various solutions by holding them at the right temperature automatically.

Plastic Covered Thermal Bulb and Tubing—is highly resistant to solutions in above processes. Prevents electrical shorts. No insulators required for the regulator.

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Bulletin 330 describes this simple, dependable control. May we send you a copy? (b31)

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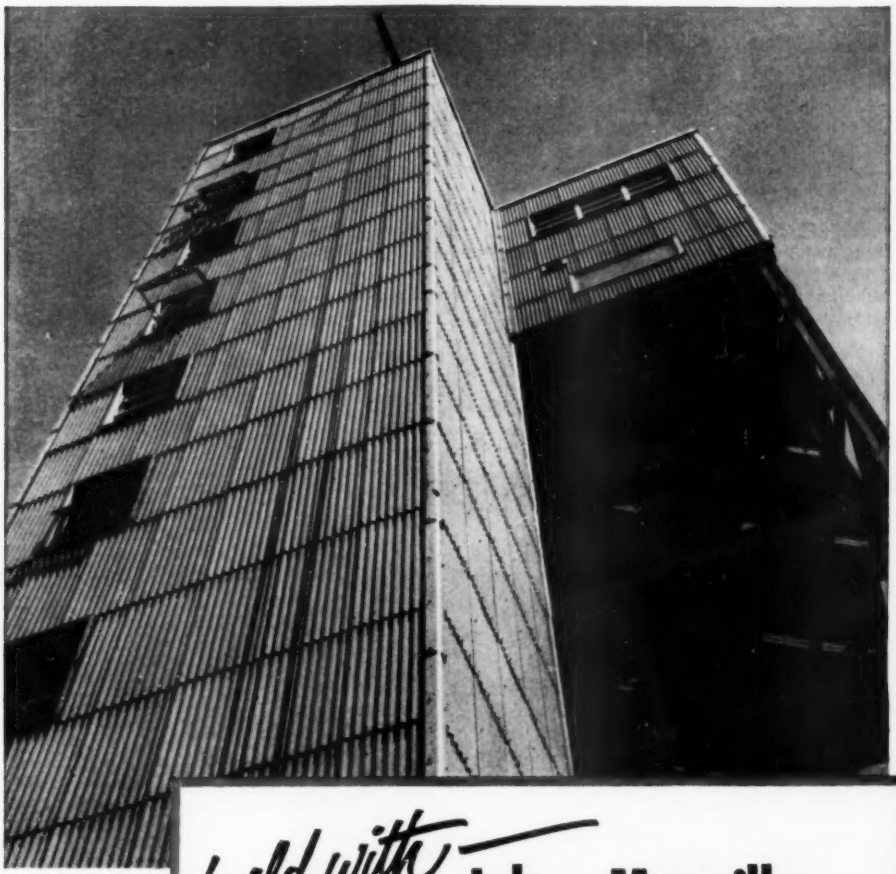
No costly maintenance problem here



Johns-Manville Corrugated Asbestos Transite gives this airport control tower an attractive, fireproof exterior that offers years of maintenance-free service despite exposure to extreme weather conditions

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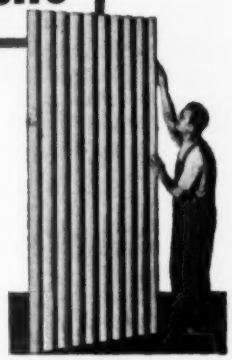

- Large sheets go up quickly
- Easy to fasten to steel
- Easy to nail to wood
- Easy to saw
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JOHNS-MANVILLE PRODUCTS

Johns-Manville

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NEW PRODUCTS

(Begins on page 110)

property makes possible uniform dispersion of pigment throughout the paint film, manufacturer explains, and yields the characteristic metallescent effect. With the use of these pigments increased durability is also claimed because the presence of the metal particles in the film serves to deflect deteriorating light rays.

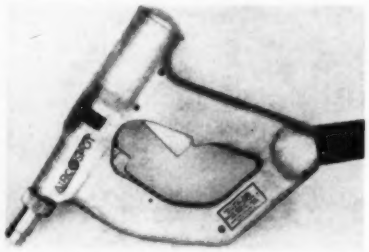
MD 584 Aluminum Paste, standard lining grade, is recommended by manufacturer for improved appearance and workability in metallescent finishes for industrial and other uses. MD 784, a fine lining grade, was developed specifically for hammer finishes and metallic enamels. A bulletin gives detailed properties. Metals Disintegrating Co., Inc.

35—STEP LADDER offers strength and stability

Made with extruded aluminum side rails and steps, the Master Step is designed to fill the need for a reasonable weight step ladder with better than average strength and stability. The back legs are heavy channel sections with reinforced braces, and the front legs are braced on both sides of the step. The steps are double riveted on the front facing. Hinge points are reinforced with additional metal plates, secured with cadmium plated steel rivets, and heavy duty corrugated rubber pads are applied to floor contact points. Extra protection against slipping is offered by saw tooth serrations on the steps. This ladder is now being produced in six sizes from 4 to 10 ft, with pail shelves omitted on the two smallest sizes. Louisville Ladder Co.

36—SPOT WELDING GUN welds steels without jigs

A light-weight spot welding gun, the Aircospot, uses a 3/32-in. non-consumable thoriated tungsten electrode and an inert-gas shield to make instantaneous welds on stainless steels, mild and alloy steels without the aid of jigs or fixtures. The operation is completed in approximately one second, according to the manufacturers. It consists of positioning the top sheet on the piece



to which it is joined, then positioning the gun and pulling the trigger.

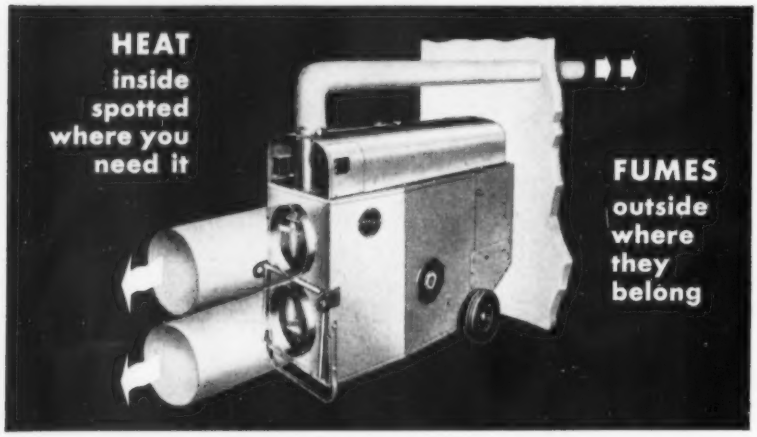
The unit consists of a hand gun, control panel and all necessary hose and cable assemblies. To use this equipment, a standard d-c power source, either motor generator set or rectifier type of machine is required. The gun is water-cooled, and uses helium or argon, or a mixture of the two, for a shield. High frequency is not required. The gun is rated at 250 amp and welds may be made on sheet metal up to ⅛ in. in thickness, with the bottom section of greater thickness. In most cases, it is claimed, a back-up plate is unnecessary. Air Reduction Sales Co.

37—ALARM WRIST WATCH times the production jobs

A watch that times production operations, laboratory phases and other jobs and calls the time in a voice you can hear, the Edscorp Alarm Wrist Watch is a 17-jewel German-made timepiece with luminous dial for night use. The alarm is set by turning the glass rim, and the tone may be adjusted to loud or soft by regulation of the sound bridge. This watch is said to be shockproof and anti-magnetic and to run 42 hours on one winding. It sells for less than $50.00. Edmund Scientific Corp.

One of these products may be "just what you're looking for." Use the handy Reader Service Cards to ask for more information on it.

SAFE HERMAN NELSON
PORTABLE AIR HEATERS



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Take a good look at this worker–

He's demonstrating why so many key men are already sold on new Scott Industrial Wipers

At the tool crib, he picks up his box of Scott Industrial Wipers . . . keeps it next to his machine all day long. Each Scott Wiper is double-ply, strong, and absorbent—designed for the entire range of industrial wiping

Because they are disposable, Scott Wipers set new standards of sanitation—help eliminate the causes of dermatitis

Each Scott Wiper is of uniform size, color and absorbency. This means, at last, you can eliminate the hidden costs of wiping operations and organize wiping in the same manner as other production operations.

Many plants have found a 90-day trial—with a Scott representative working hand in hand with their supervisory personnel—the most accurate way of measuring the advantages of Scott Industrial Wipers.

If you would like such a trial period in your plant, simply contact your local Scott representative or write Dept. PE-B, Scott Paper Company, Chester, Pennsylvania, for details.

SCOTT PAPER COMPANY

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5th Conference Program

(Continued from page 71)

groupings, and inspection routines. Justifiable preventive maintenance vs. over-prevention. Specific corrosion problems and solutions. Problems encountered in maintaining specific kinds of equipment (drying, centrifugal, compressing, pumping). Special materials used in pipe and other kinds of equipment.

Maintenance In Breweries and Distilleries

Breweries: Sanitation (of yeast rooms, processing facilities, bottling facilities). Upkeep of compressors, coils, piping, valves, control equipment. Cleaning brew kettles (methods of safe procedure). Upkeep of bottling and packaging equipment. Upkeep of pasteurizing equipment. Vat cleaning. Upkeep of conveying equipment. *Distilleries:* Sanitation problems. Upkeep of grinders, mashers, fermenters, stills, tanks, pumps, presses, filters, yeast tubs, warehouses, storage facilities, cooperage shop, handling equipment.

Maintenance In Food Processing and Packaging Plants

Organization of personnel to handle the problems peculiar to food plants. Types of inspections; follow-up on results of inspections; scheduling inspections and maintenance operations; training clean-up personnel; standard practice in dismantling and cleaning equipment; problems in lubrication; problems in connection with utilities (steam generation and distribution; heating and ventilating; electrical distribution and application; pumps, piping, valves, and traps; waste disposal). Problems in building maintenance; problems in the upkeep of food processing equipment.

Maintenance In Paper Mills and Paper Product Plants

Organization and personnel to handle specific problems peculiar to paper mills and paper product plants. Planning and scheduling maintenance shutdowns. Weekend maintenance work and attendant personnel problems. Kinds of equipment with which preventive maintenance should be used. Kinds of equipment with which breakdown maintenance should be used. Special electrical problems on account of dampness. How much duplicate or standby critical equipment? Can maintenance employees do some production work? Special problems connected with mill equipment: in beater room; in paper machine room; as to buildings in general. Special problems connected with products plant: corrugating, trimming, cutting, scoring, packaging, printing, folding, ruling, gumming, other. Disposal of mill wastes.

Maintenance In Petroleum Refining Plants

Organization of personnel to handle the specific problems peculiar to refining. Procedures for initiation and authorization of work. Planning and scheduling work. Unit turn-around practices. The spare-part and stand-by equipment problems. Items of routine maintenance. Records to be kept and uses to be made of them. Problems of protection against corrosion.

Maintenance In Sheet Metal Plants

Inspection routines, standards, and reports for the various kinds of production equipment (shears, brakes, rolls, forming presses, blanking presses, punch presses). Upkeep of the handling equipment with emphasis on preventive maintenance. Lubrication schedules and reports. Stand-by equipment. Safety problems. Lighting problems. Use of welding in repairing broken equipment.

Maintenance In Steel Mills

Problems of organization, planning and scheduling, inspection, record-keeping, and upkeep in connection with the kinds of equipment peculiar to the steel mill: electric furnaces, open hearth furnaces, soaking pits, blooming mills, shears, hot strip mills, cold mills, handling equipment, electrical equipment, other.

Maintenance In Textile Mills

Problems of organization, planning and scheduling, inspection, record-keeping, and upkeep in connection with: air conditioning equipment, electrical and mechanical power transmission equipment, electrical control equipment, floors, dyeing equipment, printing equipment, other.

* * * *

Tuesday, January 26—2:30-5:00 p.m.—Concurrent Sectional Meetings (in addition to Nos. S9 to S12 inclusive, Nos. S1 to S3—listed previously—will be repeated; No. S4 also listed previously will be continued).

Corrosion Control and Prevention

Causes of corrosion under specific conditions. Corrosion resistant materials. Prevention by painting. Characteristics of protective paints. Importance of cleaning. Neutralization of corrosive atmospheres. Offsetting corrosion in air conditioning equipment, motors, bearings, and materials handling equipment. Cost of corrosion. Cooperation of research, production, and engineering departments

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XXXX Nickel* is suited for almost any job that demands a tough in-base bearing alloy . . . for high loads at high speeds.

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Now available in units of 200,000 or 250,000 Btu/hr output

The new Dravo *Paraflo* Space Heater is designed for heating open areas in small commercial and industrial buildings. Typical installations include service stations and garages, construction offices, warehouses, recreation centers, agricultural buildings, stores, offices and showrooms.

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COMPLETELY AUTOMATICALLY AND THERMOSTATICALLY CONTROLLED— NO ATTENDANT REQUIRED

AUTOMATIC CONTROLS COMPLETELY WIRED AND FLAME-TESTED

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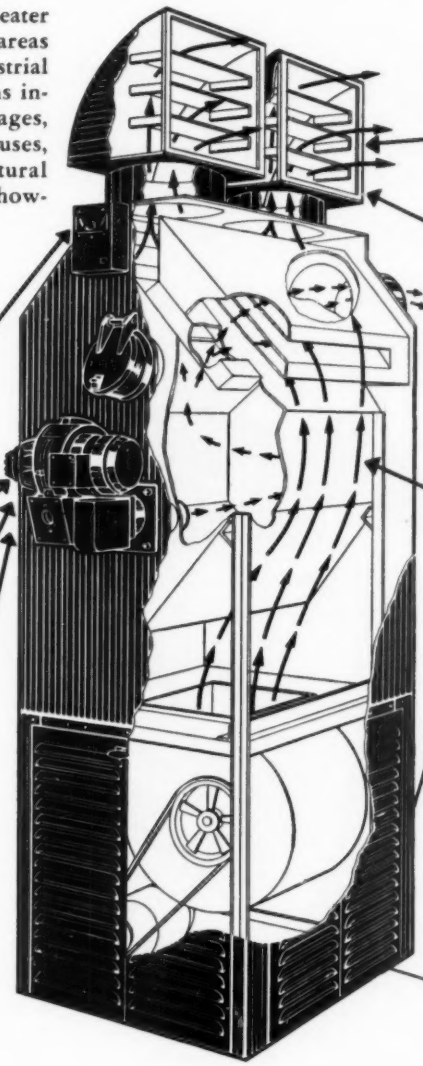

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The new Dravo *Paraflo* Heater makes available to you a complete line of oil-burning Dravo Space Heaters ranging from 200,000 to 2,000,000 Btu/hr output in the *Paraflo* or *Counterflo* series. Dravo also produces gas-fired space heaters in a range of 68,000 to 2,000,000 Btu/hr output in the Unit Heater and *Counterflo* models.

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in prevention. Cures for electrolytic corrosion. Parts replacement to increase corrosion resistance. Cite as many cases as there is time for, to make sure the overall problem is understood, and as many cures as possible are mentioned.

Maintenance in Hospitals, Medical Departments, and First-aid Rooms

Upkeep of Services: Electrical, heating, air conditioning, elevator, communication, sprinkling, resuscitation. Sanitation work done by the plant maintenance forces. Cleaning. Inspection and upkeep of special stand-by services: Electrical, water, heating, evacuation. Inspection and upkeep of patient-handling equipment: Stretchers, wheel chairs, crutches, examining tables, sterilization equipment. Handling oxygen and other gases, and keeping them available ready for instant use. Special flooring problems. Care of fire-fighting equipment; training fire-fighting crews. Routine maintenance duties. Special maintenance duties. Relationship of maintenance employees to nurse or doctor in charge.

Card Record and Analysis Systems

Using tabulating machine cards. Function of the punched holes. Kinds of jobs successfully done. How determine when cost justifies the use of punched cards and when it prohibits their use. Other types of card record systems—general descriptions, and jobs for which suitable.

Waste Disposal Problems and Solutions

General classification of industrial wastes: Gaseous, liquid, solid, noxious, poisonous, deleterious. Objections because of: Smell, sight; cost to offset effects; spoiling streams for fishing, bathing, and as water supply; others. Legal attitudes of states or communities. Methods of treatment and disposal, costs by products. Cite as many case examples of treatment and disposal as possible. Give specific costs where possible.

* * * *

Wednesday, January 27—9:00-11:30 a.m.—General Session.

Maintenance Cost Control and Budgeting

(a) *Summation of Principles.*

Stating the objective of maintenance budgeting. Defining the objectives with which the maintenance executives are concerned. Showing cost-control relationship of budgets to form and size of personnel organization. Tie-in of budgets with maintenance planning. Showing how cost reports and analyses can be used to measure the effectiveness of the maintenance job. Listing the maintenance cost reports that the average plant should have. Showing how records can be used in deciding on equipment replacements.

(b) *Case Example I.*

Description of an actual, effective cost control and budget system. Speaker to tell just what the cost and budget department does; how the budgets are used; how the cost-findings are used in control operations. This case to be taken from a middle size plant with between 1,000 and 2,000 shop employees.

(c) *Case Example II.*

Same as (b) except to be taken from a small plant with under 500 employees.

Wednesday, January 27—2:30 to 5:00 p.m.—Concurrent Round-Table Discussions. (These are repeats of the discussions held on Tuesday morning.)

Wednesday, January 27—8:00 to 10:00 p.m.—General Session.

ROUND-UP of answers to all questions unanswered at the preceding General Sessions and Sectional Meetings, plus answers to questions placed in Question Boxes before Wednesday noon.

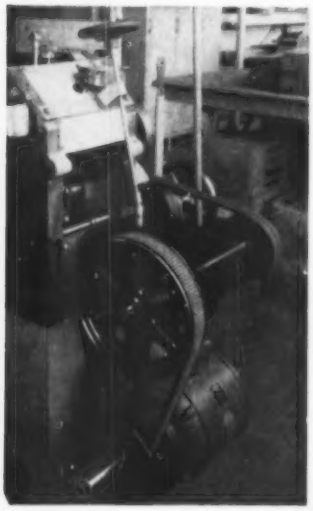
Incentive Systems

(Continued from page 81)

particular section of the work; in other words, he or his department were responsible for co-ordinating the whole operation.

When the work instruction cards reach the foreman, he is responsible for the initial investigation into the job, to decide what equipment, materials, etc., are required and to indicate the availability of the plant. The Planning Engineer is responsible for deciding the priority of the work, and this is done after discussion with departmental heads. The specifier next works at the times allowed. The instruction cards are then "loaded" on to a work board, against the particular operative who will be allocated to the job, job specifications being attached to the card. It is very desirable that a reasonable work load is made available to each worker, to avoid delays in waiting for instructions; we have aimed at a two weeks' loading.

On the completion of the job, the work being satisfactory, the foreman signs the instruction card and returns it to the Planning Engineer, who, after extracting the necessary information for recording all relevant details against a particular



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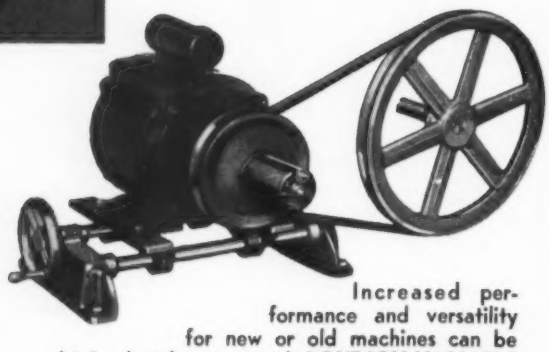

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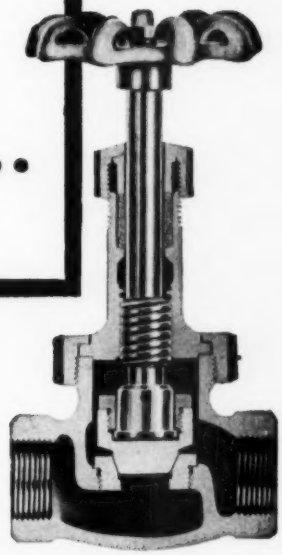
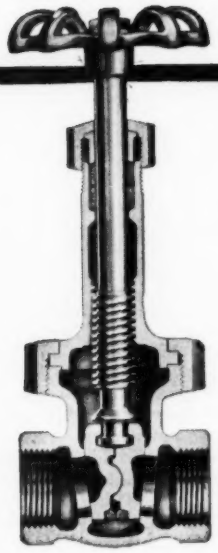
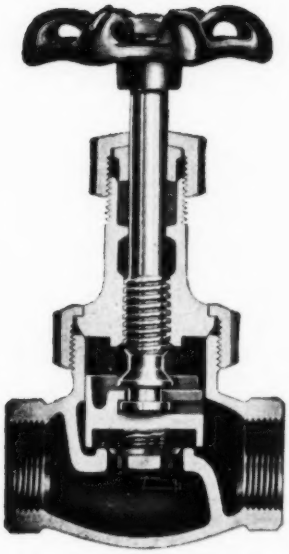
Walworth bronze valves...



Walworth No. 225P Globe Valve
500 Brinell Seat and Disc



Walworth
No. 29 Gate Valve



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Re-New-Disc

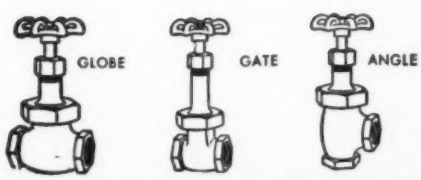
built to give dependable trouble-free service on all recommended jobs

Walworth No. 95 Bronze Globe Valves (Angle Type: No. 96) are recommended for service where throttling is not required. They are rated at 150 psi working steam pressure, 500F; 300 psi cold water, oil or gas. The improved renewable disc and lock-on, slip-off disc holder — an original Walworth development—saves time and trouble. This valve can be repacked under pressure when fully opened. All parts are designed to give maximum service and strength.

Walworth No. 29 Bronze Gate Valves are rated at 200 psi working steam pressure, 550F; 400 psi cold water, oil and gas. These valves have rising stems and integral seats. Sizes 2-inch and smaller have union bonnets; sizes 2½ and 3-inch have bolted bonnets. Valves up to and including ¾-inch have solid wedge discs; 1-inch and larger have split wedge discs. These valves can be repacked under pressure when fully opened.

Walworth No. 225P Bronze Globe Valves (Angle Type: No. 227P) are rated at 350 psi working steam pressure, 550F; and 1000 psi non-shock service on cold water, oil and gas. The stainless steel, plug type seat and disc — heat treated to 500 Brinell — can be closed on sand, slag, scale and similar floatage, without injury to the seating surfaces. They are the longest wearing, TOUGHEST bronze valves you can buy.

For full information about Walworth Quality Bronze Valves, see your Walworth distributor, or write:



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part of the plant, forwards it on to the Accounting Department, for bonus payment.

During the course of any maintenance work, it is obvious that "unforeseens" will crop up and in this case the operative informs his respective foreman of the difficulties encountered and any extra time involved is classed as a contingency, for which, depending on circumstances, either standard time or an agreed time allowance is given.

In all disputes it is laid down that the work proceeds while proper investigation is made through the appropriate channels.

In the case of the departmental maintenance worker it was accepted that he was on "tap" for the production operators. At the same time it was realized that there was a lot of waiting time; the better the plant was running the more this element grew.

It was decided then to draw from the maintenance schedules and build up a routine load of from 40 to 80 per cent of the operator's hours, much of this schedule being inspection and report as part of the Preventative Maintenance Plan, leaving the remainder for process requests, bonus being paid on a percentage basis against this routine load. There was obviously the incentive to get the routine work out of the way to leave time for any possible job requests coming in.

It is almost axiomatic to avoid group systems wherever possible. In our investigation, however, we were unable to avoid it completely, so where this was inevitable, specifications were very strictly broken down into reasonable elements. This was done in such a way that if one worker's section was of a lower work load, he was expected to assist in the larger elements—non-compliance with this adversely affecting the overall group payment.

Such duties as oilers and greasers have not been dealt with here, the reason being that it was considered a matter for time study, and indeed proved to be a reasonably straightforward application using a penalty system based on an 8 per cent to 15 per cent inspection.

Heat Treating Furnaces

(Continued from page 83)

fired furnace to meet Ryan specifications. The design incorporates a number of interesting innovations.

To accommodate the tall afterburners, the heating compartment was designed as a large brick-lined structure without a bottom and with a front door entry. In a concrete pit, directly in front of the furnace, two mobile loading cars can be loaded from adjacent floor-level platforms. By means of a hydraulic piston, these cars are switched from the loading platforms to the center tracks which lead into the furnace. When loaded with three afterburners, one car is rolled under the furnace bringing the afterburners into the heating compartment. Electric motors hoist the car six inches and close the heavy steel sliding door to effectively seal the compartment.

Although this facility is not a completely controlled atmosphere type, satisfactory regulation of atmospheric conditions is maintained through an ingenious combustion arrangement. The gas burners are located along the top sides of the furnace. Air and gas are injected, separately, in proportioned amounts into a special combustion chamber at the top of the furnace. Only sufficient air for supporting combustion is automatically valved in order that no excess amounts are present to cause oxidation.

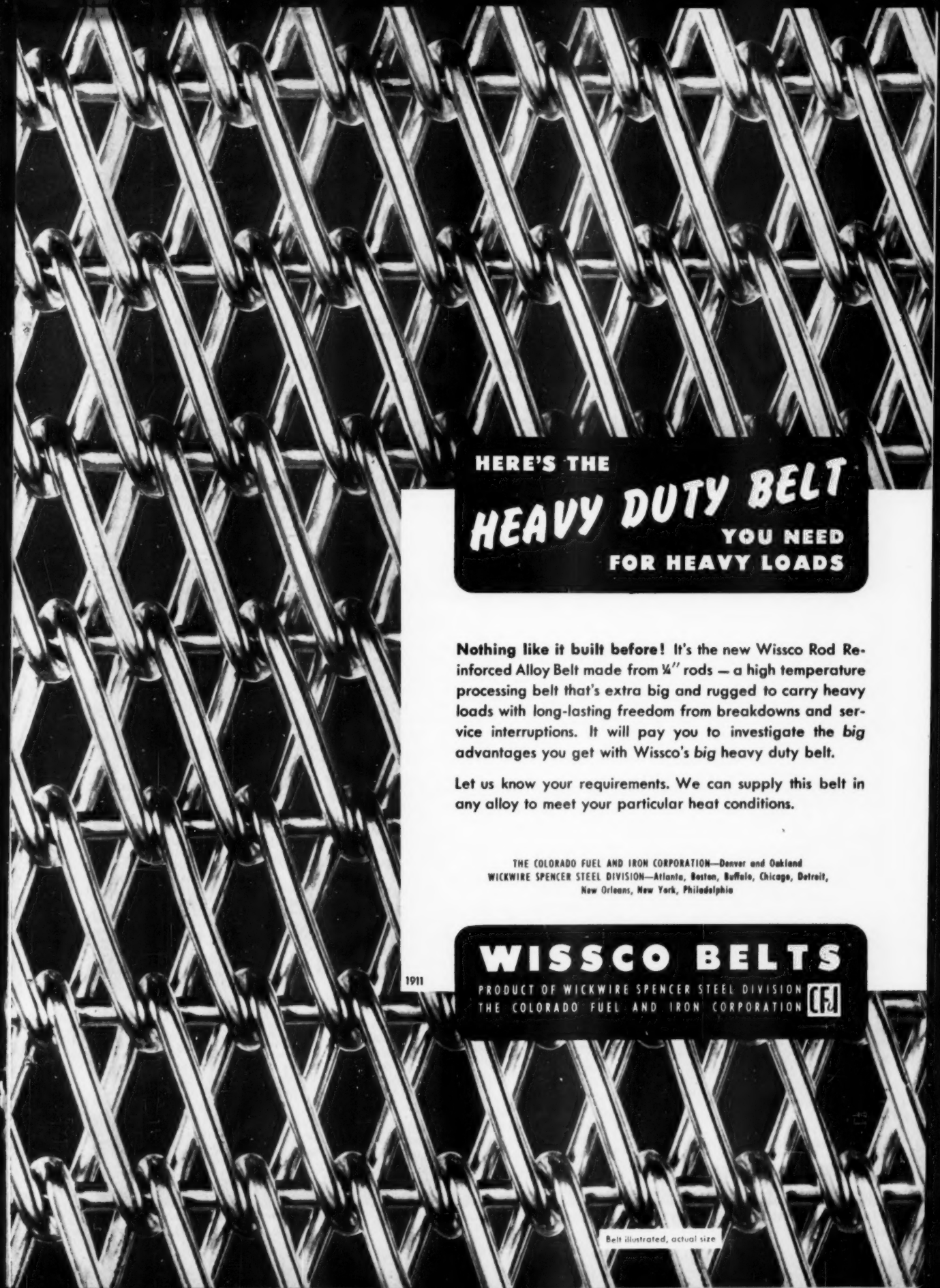
The hot gases are forced down into the heating compartment through slot-like openings in the fire-brick ceiling. They circulate through the afterburners, pass through ducts near the floor and rise in the furnace walls to again enter the combustion chamber. Pressure in the furnace is maintained at from one to two inches of water and excess gas is vented off from the furnace top.

In addition to stress relief, this furnace also accomplishes age hardening of the alloys used in the afterburners. This especially tough alloy, designed to withstand the extreme temperature encountered in afterburner operation, attains its maximum strength through heat treatment. This treatment is deferred until the structure has been fabricated, to render it more ductile for forming, and is then applied along with the stress relief heat treatment. At a temperature of 1450 F, the afterburners are stress relieved and age hardened to top strength.

In the recently installed Knapp furnace, Ryan has obtained a larger capacity heat treating facility of similar type to those which have proved their usefulness at Ryan over a number of years. These furnaces are gas-fired, electrically-controlled ovens which are used both for heat treating exhaust systems and jet engine components.

In the forming of stainless steel alloys for aircraft exhaust systems one or more heat treatments are required to anneal the metals. This is due to the deep-contoured designs of modern manifolds and the definite tendencies of the stainless steel to work-harden rapidly under forming. By heating these stampings to the 1800-1980 F range, the residual stresses caused by forming are relieved and the metal is softened so that further forming can be performed without risking cracking.

Ryan plant engineers have designed and built quick loading mechanisms for the Knapp furnaces which permit the loading of parts,



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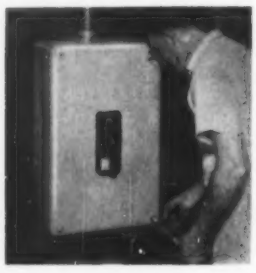

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hydraulically, through pushbutton control. This has resulted in greater safety for operators, by removing them from the proximity of hot parts, and faster furnace operations with less heat loss through open doors.

These furnaces are not controlled atmosphere types but effective regulation of the amounts of air entering the furnace can be arranged through air and gas mixture controls. In this way, a reducing atmosphere is attained in the furnace so that there is slight oxide formation while the parts are in the furnace. These furnaces do not have controlled cooling cycles or atmospheric regulation when the parts are removed from the heating compartment so that oxide scale forms as soon as the parts are removed from the hot interior and the cold air strikes them.

Ryan removes this oxide scale through a series of acid baths which return to the metal a bright finish. In the process, some metal is lost but these exhaust system parts are not critical in dimension to the extent that the loss of a few ten thousandths in thickness will affect their usefulness.

Specifying Castings

(Continued from page 98)

Every casting buyer should be familiar with the standard foundry terms and conditions of sale which have joint approval of the foundry industry and the National Association of Purchasing Agents. An agreement of this type with the non-ferrous foundry industry was finally approved in December 1952. Agreements with the iron and steel foundry industry previously had been approved.

On the whole, these agreements are satisfactory, but the condition which states that defective castings must be reported and returned within 90 days could give trouble if a foundry should insist on living up to the letter of the law of this provision. If necessary, supplemental agreements should be made with the foundries from whom castings are purchased to extend this period to six months. Also, it is a good policy to have understood that in the case of large quantities of castings that the entire lot can be rejected without machining each and every one if upon starting the machining operation a majority are found to be defective.

Occasionally, especially when castings are very tight, foundries will ask the purchaser to furnish flasks. Those plants which have foundries of their own might do this, and upon completion of the job use the flasks in their own foundry but the chances of this probably are small. The practice of furnishing flasks should be discouraged.

The matter of repairing castings and charging back the cost to the foundry is very important. Permission to do this should be confirmed in writing to

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Just 1/32" (pinhole size) faucet leak

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of approximately 95,000 gallons of water yearly—costing:

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$88.91 if coal (9679 lbs.)
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Above figures authenticated by Hackensack Water Co. and American Gas Association.

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Built like a tire with fabric re-inforcement they resist the grinding, closing squeeze that SPLIT and MUSH ordinary washers out of shape...causing LEAKS.

Through combining NEOPRENE and FABRIC RE-INFORCEMENT they OUTWEAR ordinary washers 6-to-1 on hot or cold FAUCETS—thus you slash water, fuel and labor costs.

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prevent unpleasant relationships when back charges are made.

The cheapest casting often is, in the final analysis, the most expensive. In the matter of price, every buyer must use all of his experience and horse sense to get the best casting at the best price. It can well be repeated that especially in the case of castings, there is "economy in quality."

Ventilating Gas-Air Mixtures

(Continued from page 74)

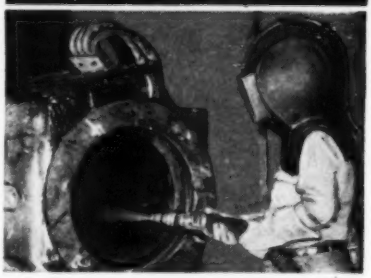
and vapors diffuse slowly while others develop intimate mixtures quickly. Fig. 1 lists gases and vapors found in common practice. It is evident that ammonia diffuses in air about twice as fast as carbon disulfide and that the lighter the gas the faster it diffuses. Hydrogen, the lightest of all gases, diffuses about 3½ times as fast as carbon monoxide.

A vapor such as gasoline that is heavier than air tends to settle in low spots and, although gradually mixing with the air, if not affected by drafts and other forces mentioned above will remain in these low spots for a considerable length of time. Here local exhaust treatment will give the greatest benefit. A gas such as illuminating gas that is lighter than air tends to rise but diffuses fairly rapidly so that in a building the gas would soon be distributed throughout the room into which it is discharged.

The method of ventilation may be either natural or mechanical. Natural ventilation has the advantage of being in continuous operation but is affected by the vagaries of wind direction and intensity. It is independent of power source. Pivoted windows with roof ventilators are a good means of natural ventilation. Mechanical ventilation is more positive and should be used in most cases, particularly where operations are extensive. Its effect is independent of wind velocity and direction and temperature difference between indoors and out.

If exhaust must be taken at the floor line, it must be located as close to the source of contamination as possible. If not, sufficiently great quantities of air must be drawn across the point of contamination to adequately dilute the gas. Serious error is likely to result, however, if an insufficient amount of air is provided to control the vapors by either of the two methods above.

When large quantities of air must be withdrawn for effective dilution of the gas or vapor, it may be desirable to exhaust it at points near the floor for the sake of minimizing heating difficulties in cold weather. On the other hand, if exhaust inlets located at higher levels can be made to entrain appreciable quantities of vapor by local exhaust then the amounts of air handled are reduced.



SAVES TIME BECAUSE DRYING PERIODS ARE UNNECESSARY!

The Pangborn AC-4 Blast Machine cuts down-time to less than half by *eliminating waiting* for parts to dry . . . by *cleaning faster* . . . by *requiring no dismantling* in most cases. It uses soft 20-mesh corn cob grits to remove dirt, grease, old paint, etc. quickly and efficiently, without harming coils and other delicate parts. Look at these features:

- **Cleans in less than half the time of other methods**
- **Requires no drying periods**
- **Material costs average 90% less than old-fashioned methods**
- **Does better job, leaves parts clean and bright**
- **Eliminates toxic hazards of solvents**
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Write for complete information, telling us what you clean, to: PANGBORN CORPORATION, 3200 Pangborn Boulevard, Hagerstown, Maryland.

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PLASTIC GRIPPING RING

- Seamless, pliable, oilproof plastic forms perfect seal with plastic conduit sheath.
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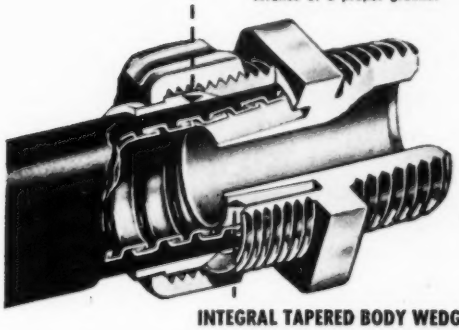
- Blue color gives visual installed insurance of a proper ground.



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Seal out all moisture, oil, and corrosive fluids with this easy-to-install, self-grounding connector . . . a connector specially designed by T&B for Types UA and EF (J.I.C. Standard) liquid-tight flexible metal conduit.

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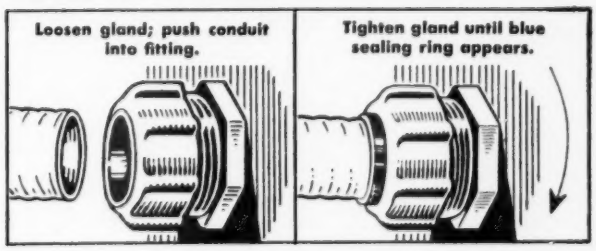

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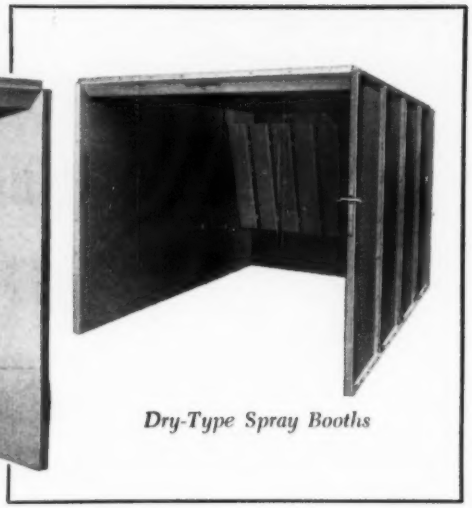

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DeVilbiss Standardized Spray Booths – water wash, dry type, bench or leg type – are based on standard panel sizes.

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(Continued from page 34)

ing and cutting operations. Also described are pipe cutters, nipple chucks, chip strainers, reamers. Beaver Pipe Tools, Inc.

135 To Trim Welding Costs—"The Case of the Ailing Weldollar," 12 pp, analyzes basic causes of high welding costs and suggests a plan to reduce them. Explains how company's motor-generator d-c welder provides the high usable welding currents, faster speeds and reduced downtime which contribute to lower overhead and labor costs. The Lincoln Electric Co.

136 Rod Selector Chart—Arranged to facilitate selection of proper welding alloy for a specific job, this wall chart lists over 100 "Low Temperature Welding Alloys," their bonding points, tip colors, tensile strengths, classified by type of metal and further subdivided by arc or torch applications. A brief description of main uses for each rod and electrode is included. Eutectic Welding Alloys Corp.

137 Belt Grinding—This 12-pp booklet, Form A-AiF, describes company's method of using coated abrasive belts as a high-speed means of grinding and finishing flat or contoured surfaces of all kinds of metal, from soft brass to super hard tungsten carbide, also glass, plastics, ceramics and hard rubber, faster cut, cooler operation, lower unit costs. Shows abrasive belt machines. Minnesota Mining & Mfg. Co.

138 Lathes and Shapers—Sixteen-pp Form CC-2 presents ordering information on lathes, shapers, and accessories. Features company's new 12-in. swing lathes designed for extreme rigidity and smoothness under heavy cutting loads, and offering a variable speed drive as optional to standard V-belt drive. Well illustrated. Logan Engineering Co.

139 Ultrasonic Cleaning—How the ultrasonic generator works, the principles of high-frequency sound cleaning and examples of applications are explained in Bulletin GEA-6056. Tells how the ultrasonic action of the generator can hasten cleaning of parts by as much as 100 times. Illustrates components of equipment. General Electric Co.

BOILERS AND AUXILIARIES

140 Water Tube Boilers—Features of company's Type "C" boiler, described in Bulletin SB-49, include large water holding capacity, fast steaming, large steam relieving surface, and production of superheated steam from a standardized design. Discusses method of steam take-off through a bank of tubes into a header. Gives dimensions. Erie City Iron Works.

141 Oil-Gas Burners—Bulletin 5053 is a 16-pp illustrated catalog on horizontal rotary oil burners, combination oil-gas burners, and forced draft packaged burners for oil and combination oil-gas firing. Covers features of the burners, including Oil Volumeter, pre-wired control panels, ignition system, oil pre-heating apparatus. Iron Fireman Mfg. Co.

142 Feedwater Heater—Six pp Bulletin S-217 describes baffle spray type deserating feedwater heater. Lists special features including counter flow principle, vent condensers, engineering for individual requirements of each user. Shows how unit saves fuel, reduces boiler repairs and stops corrosion caused by oxygen and carbon dioxide. Stickle Steam Specialties Co.

WIRE ROPE AND SLINGS

143 Buying Wire Rope?—This bulletin, "What's the Difference in Wire Rope?" answers questions that puzzle a rope buyer. Explains differences in wire used in various rope, differences in manufacturing processes, and in results. Leschen Wire Rope Div., H. K. Porter Co., Inc.

144 Sling Data Book—Up-to-date information on company's Gripper slings and current price list are provided in this 20-pp booklet. Pictures 24 typical applications of these slings, discusses safety features, other advantages. Standard sling fabrics are illustrated, engineering data and dimensions given. Cambridge Wire Cloth Co.

THIS MONTH'S LITERATURE OF MERIT treats storage batteries . . . abrasive cut-off wheels . . . hot water heaters . . . floors . . . expansion joints

145 Handbook on Storage Batteries—This 64-pp booklet of instructions and technical data is the sixth edition of this company's battery service manual. Provides a brief treatise on the theory of the lead-acid battery. Gives detailed instruction on the care and operation of batteries, on maintenance and repairs, and on standard and special parts. Booklet is of special value to plant engineers concerned with storage batteries for cycle service in industrial trucks and materials handling equipment. Gould-National Batteries, Inc.

146 Abrasive Cut-Off Wheels—A revision of company's excellent manual on cut-off wheels, this 36-pp booklet contains much that is completely new. Gives information on various types of cutting-off machines and abrasive cut-off wheels, their selection, application and proper usage. Illustrates typical cutting-off operations, and provides helpful tables for wheel selection and conversion of wheel speeds to feet per minute values. Norton Co.

147 Hot Water Heater Code—Twenty-pp Bulletin 11 is a newly revised edition of the "Standard Code for Testing and Rating Hot Water Unit Heaters" and it uses present day instrumentation and practices. Provides a standard method of testing and establishing capacities and performances of hot water unit heaters. Covers equipment for testing, procedure, computation of tests. Booklet is issued jointly with the American Society of Heating & Ventilating Engineers. Industrial Unit Heater Assn.

148 Floors and Floor Problems—This generously illustrated 24-pp booklet explores various types of floors and their construction, as well as factors entering into floor deterioration and the diagnosis and treatment of floor troubles. Why wood floors deteriorate and why concrete floors deteriorate are among subjects covered. Other sections of booklet are devoted to special problems of industrial floors and those of offices, institutions. Tremco Mfg. Co.

149 Expansion Joint Design Guide—Bulletin 135, 24-pp, contains engineering application and selection data on pipeline expansion joints. The guide features a discussion of the types of expansion joints available and kinds of pipeline motion solved by them. Also covered are expansion joint design considerations and installation instructions. Includes schematic piping layout illustrating various expansion joint principles. Flexonics Corp.

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MECHANICAL POWER TRANSMISSION

150 V-Link Belting — Data Book B220 lists prices, sizes and typical applications of manufacturer's V-link belting, together with engineering and maintenance data. Tables and charts give installation and selection information. Brammer Corp.

151 Lubrication of Chain Drives—Vol. 39, No. 8 of Lubrication offers a 16-pp discussion on chain drives and their lubrication. Covers types of chains, conditions affecting their lubrication, choice of lubricants. Includes table showing lubricant recommendations for chain drives. Generously illustrated with photos and sketches showing chain arrangements, methods of lubrication. The Texas Co.

152 Split Roller Bearings—This 16-pp illustrated catalog presents anti-friction bearings "split right down to the shaft" to permit use of anti-friction bearings in many difficult applications. Design details and types available are described and illustrated and dimensions included. Booklet also provides practical suggestions for selecting the proper bearing for the job. The Cooper Split Roller Bearings Corp.

INSTRUMENTS, CONTROLS

153 Flow Signal Transmitter — Bulletin 2653 illustrates and describes a combination 1500-psi liquid line-flow measuring element and pneumatic flow-signal transmitter with square root extraction cam for linear indication, recording or control of furnace fuel and process liquids. Discusses advantages of integral measuring orifice with differential-pressure bellows, requiring no sealing fluids. Hagan Corp.

154 Temperature Controller — Twelve-pp Bulletin P-611 introduces an electronic temperature controller, with range covering -100 to 600 F. Contains specifications, prices, application information on single-point and new cascade model, also data on resistance thermometer elements and wells, and control motors. Industrial Div., Minneapolis-Honeywell Regulator Co.

155 Remote Level Indicators—Twenty-pp Bulletin WG 1824 presents remote liquid level indicators for boilers, heaters, storage tanks, discussing their applications and outstanding features. Explains how the indicators are designed, how they operate, and how they are installed. Typical applications are diagrammed and installations pictured. Includes information on temperature compensating unit for higher pressure applications. Yarnall-Waring Co.

156 Industrial Inferential Meter—Bulletin 500, 16 pp, describes company's Type MO meter, with data on operation, construction, accuracy, primary devices, and general information for plant engineers who deal with fluid flow problems. According to catalog, this meter, available in indicating, recording and totalizing form, can be operated as direct mechanical instrument or as electric or pneumatic transmission unit. Simplex Valve & Meter Co.

157 Dynamic Flow Control—Introducing a new valve-mounted controller for high speed flow application, 8-pp Bulletin 470 divides a typical flow control system into four components: controller; set point transmitter; measurement transmitter, and control valve. A two-page explanation of the new mechanism discusses provisions for proportional, derivative and reset control actions. The Foxboro Co.

158 Vertical Scale Indicator—Illustrated Bulletin 1541 describes a 6½-in. wide Electronic instrument for rapid and precise multiple indication of any variable that can be transformed to multivolts within limited panel space. Lists components, specifications. Industrial Division, Minneapolis-Honeywell Regulator Co.

159 Electronic Controls—Eight-pp Catalog F 6166 describes flexibility of an electronic control system for heating, ventilating and air conditioning. Describes temperature controls, control panel, sensing elements, as well as the ultra-sensitive micro relay which simplifies the amplifier. Barber-Colman Co.

160 Flow Meter—Eight-page booklet 52-1017-37 describes meter for measuring air and gas flow and ratio of air to gas flow. Shows how meter can be used in connection with industrial furnaces, sewage disposal plants, also in cost accounting, to accurately meter and charge cost of air delivered to various departments or processes. Lists several models. Hays Corp.

METALS

162 Clad Metals—This 24-pp pocket-size booklet gives a comprehensive survey of the manufacture and applications of stainless, copper, brass and other clad metals. Beginning with a definition of "combined" and "clad" metals, booklet lists characteristics, and illustrates basic equipment and processes used in past and present cladding methods. Superior Steel Corp.

163 Data on Chromium Steel—Bulletin A-49, 32 pp, on corrosion resistance of chromium nickel steels, contains 18 tables showing results of tests on numerous austenitic stainless steels in acid, neutral and alkaline solutions. Covers mechanism of corrosion resistance; factors affecting corrosion; behavior in various corrosive environments, in industrial atmosphere, in organic and inorganic acid salt solutions and in halogen salts and weak and strong bases; and preferred practice in construction and use of these steels. The International Nickel Co., Inc.

164 Iron Powder Parts—Some production facts about mechanical parts fabricated from electrolytic iron powder are presented in this 28-pp booklet. Curves showing elongation, as well as tensile, yield and impact strengths indicate that parts made from this powder can have high strength and operating results reported show adherence to close dimensional tolerances with substantial cost savings. Plastic Metals Div., The National Radiator Co.

PUMPS, PUMPING

166 Little Pump for Big Job—A small, compact pump designed to do a big job economically is described in this bulletin. Explains design and maintenance features of this low cost pump for water softening and boiler treatment up to 300 psi. Orchem Pump Div., Orlich Bros. Machine Works.

167 Controlled Volume Pumps — Complete data on manufacturer's "miniPump" line of controlled volume pumps are given in 10-pp Bulletin 653. Included are capacities, pressures, materials of construction, operating details. Illustrations show typical speed and stroke length control of capacity; constant flow; air operated, and multi-plex units. Milton Roy Co.

OTHER EQUIPMENT

168 Low Cost Slide Film—This little 20-pp booklet tells how you can combine tape recordings and color slides to make a slide film presentation for less than $20.00. Shows how use of magnetic tape and 35 mm slides offers solution to problem of putting ideas across to employees effectively, and tells where this audio-visual method of training is especially applicable. Outlines five steps required to produce a slide-sound presentation. Minnesota Mining and Mfg. Co.

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169 Silicon Carbide Facts—Properties of silicon carbide as related to its use in abrasives, refractories and refractory cements, electric heating elements, resistors, catalyst carriers, porous media, and deoxidizers in metallurgy of iron and steel, are presented in this 52-pp booklet. Manufacturing techniques are outlined, and an extensive bibliography is included. The Carborundum Co.

170 Industrial Tape Dictionary—This 16-pp booklet providing easy identification of pressure sensitive tapes is designated a "tape number dictionary." Includes information on hundreds of such tapes, with each number listed in sequence with manufacturer's name and each described as to construction. Pocket-sized, this booklet offers good help in determining right tape for a specific job. Polyken Industrial Tape Dept., Bauer & Black Div.

171 Solids Contact Reactor—Bulletin 5001-A, 24 pp, discusses a solids contact reactor for clarifying and/or lime softening of water. Explains advantages of this principal, including its catalytic effect, accelerated reactions and larger precipitates, cutting down of detention time, and saving of chemicals. Illustrates basic reactor types available. Cochrane Corp.

172 Pressure Equipment — Twelve-pp Catalog 400 covers manufacturer's line of separators, exhaust heads, traps and strainers, and boiler trimmings. This new catalog condenses the information given in three other catalogs (each on a particular class of equipment) and it gives adequate size and pressure tables and technical data on the most frequently used equipment. Wright-Austin Co.

173 Liquid Seals—Bulletin 241 tells how to keep high pressure refrigerant gas out of evaporator when liquid level in receiver drops below outlet pipe. Covers operation, selection and installatfon of cast semi-steel and forged steel liquid seals and expansion valves. Includes selection charts for ammonia, Freon and Carrene refrigerants. Armstrong Machine Works.

174 Permanent Magnets—Uses, design, properties of Alnico permanent magnets, sintered grade 5, are discussed in 6-pp Technical Report PM-111. Charts, graphs and photomicrographs show magnetic and physical characteristics of these magnets. Carboloy Dept., General Electric.

175 Chemicals for Basic Industries—AD Form 277 describes briefly a line of chemical products including activated calcined, low-soda, tabular, hydrated and catalyst aluminas; fluoride; cryolite; and gallium. Their advantages and uses as dessicants, dehydrants, catalysts and catalyst carriers, refractories, and other uses, are listed. Aluminum Co. of America.

176 Communication Systems—Sixteen-pp Form P 831 presents communication systems engineered for power plants. Advantages of such a system are given and photos show it in use in turbine rooms, boiler rooms, control rooms, laboratories and outdoors. Amplifiers, handsets, speakers, wall baffles, signal lights, switches and master control equipment incorporated in these systems are covered in detail. RCA Victor Div., Radio Corp. of America.

177 Stainless Steel Fastenings—A complete inventory of stainless steel fastenings is itemized in 20-pp Bulletin 53-B. Includes cap screws, nuts, washers, machine, sheet metal, wood and set screws, as well as pipe fittings. Catalog suggests short cuts in ordering to keep costs down, and provides charts explaining AN specifications and decimal equivalents. Dimensions of equipment are listed, along with recommended sizes for each application. Star Stainless Screw Co.

178 To Rout Scale, Rust—A 28-pp booklet, Form 4305-R-13, details use of company's Compound 32 in removing hard water scale and rust deposits. Gives advantages of its use, tells methods of use including safety measures to be observed when using acid solutions. Treats in detail the use of this compound in diesel engine cooling systems, scrface condensers, heat exchange equipment, mechanical refrigerating equipment, water and steam meters, in heat treating operations, other applications. Oakite Products, Inc.

INSTRUMENTS, CONTROLS

201 Handbook on Automatic Controls—Catalog 700 provides 45 pp of ordering and application data on automatic controls with mercury contact switches. Covers control equipment for temperature pressure-low water, liquid level, bottles; transformer-relays, valves. The Mercoid Corp.

202 Industrial Controls—Catalog 8305, 84 pp, describes and illustrates non-ind cating electric, electronic and pneumatic controllers for temperature, pressure and humidity; also pneumatic and electric valves, switches and relays. Indexed and compiled for easy use, catalog provides specifications, dimension drawings, application data and ordering information. Industrial Div., Minneapolis-Honeywell Regulator Co.

203 For Continuous Level Indication—A continuous level indicator, for liquids, granular solids, viscous fluids, powder, etc, is described in this 8-pp bulletin. Stresses features of the instrument and describes both electronic measuring unit and indicator. A typical installation is shown and operation is explained. Fielden Instrument Div., Robertshaw-Fulton Controls Co.

204 Orifice Meters—Bulletin 1050 Rev. 1, 28 pp, shows how manufacturer's orifice mete.s are made, how they operate. Tables give capacity data, and there are descriptions of manifold arrangements and differential ranges, along with illustrations of various parts. Sketches show how meters are used with liquid seal chambers and piping for steam, corrosive gases and liquids. Rockwell Mfg. Co.

205 For Liquids Worth Storing—Bulletin 6405 offers an illustrated discussion of company's self-contained gages for liquid level applications, covering both direct- and remote-reading types, also a dial type hydrostatic gage. Stresses value of measuring stored liquids. Liquidometer Corp.

206 Wide Range Regulator—Featured in Bulletin 316 is an expansion stem type temperature regulator operated by water or compressed air. Explains how regulator works. The Powers Regulator Co.

207 Gages for Many Jobs — Sixty-eight pp of liberally illustrated information is offered in Catalog 64. Describes a variety of gage types; air volume controls for pump installations, vapor tension thermometers, d-c ammeters and voltmeters, and water flow meters covered. Includes engineering tables. United States Gauge Div., American Machine and Metals, Inc.

VALVES, TRAPS, PIPING AND ACCESSORIES

208 For Quick Valve Selection—Here's a 20-pp catalog digest providing ordering and application information on gate, globe, angle and check valves in bronze, iron, cast and forged steel construction, also valve accessories and parts. Illustrated and thumb-indexed, includes pressure-temperature chart. The Ohio Injector Co.

209 Bronze Valves—Globe and angle bronze valves with rising stems, union bonnets and stainless steel plug type seats and discs are described in this bulletin. Discusses design advantages, gives dimensions and specifications. Walworth Co.

210 Valves and Fittings—Illustrated Catalog 47 provides over 60-pp of ordering information and application data on valves and fittings made of stainless steel and other corrosion resistant alloys designed for use where corrosion or contamination are factors. Gate, globe, and angle valves for a wide range of services are presented, also needle valves, sampling valves, screwed and flanged fittings. Design and construction details are shown. Also included is a chart of first and second recommendations of alloys for corrosive media. Alloy Steel Products Co., Inc.

211 Valve Maintenance Guide—"Prevent Valve Failure Before It Starts," is a 28-pp text on valve selection, installation, inspection. Pictures damaged valves, explains how damage could have been prevented. Discusses maintenance schedules, inspection jobs, lubrication, pipe line checking, threading, regrinding, disc replacement. Jenkins Bros.

212 Lubricated Plug Valves—Revised Catalog PV-2, 12 pp, presents steel and semi-steel valves designed to offer quick shut-off of erosive or corrosive fluids. Explains advantages of the lubricated tapered plug design of these valves and pictures single gland, screwed gland, and bolted gland types. Also shows replacement parts and accessories for these valves. The William Powell Co.

213 Automatic Valves—Pressure, flow, and liquid level controls for steam, air, gas and fluids are shown in 90-pp Catalog A-50. Includes sizes, prices, capacity charts, conversion tables. Davis Regulator Co.

214 Valves for Processing—General Catalog 1500 B, 20 pp, describes in detail the operation and performance of all of company's single seated valves—the Domotor, electro-pneumatic, handwheel and combination models. Optional assemblies for specialized applications are shown. Application information, operating characteristics given. The Annin Co.

215 Steam Trap Reference Manual—Bulletin T-1740, 24 pp, tells why and where steam traps should be used; explains desirable trap features. Advantages of company's impulse steam traps are described, their operation illustrated. How to figure trap sizes and how to size condensate return lines are told and capacity and pipe dimension charts and thermodynamic properties of saturated steam included. Yarnall-Waring Co.

216 Steam Trap Book—Catalog J, 44 pp, includes physical data and prices on cast semi-steel and forged steel inverted bucket steam traps, compound steam traps and ball float air and air relief traps; a handbook section explaining how to calculate condensate loads and select traps for all classes of equipment; a maintenance section. Armstrong Machine Works.

218 Steam Hook-ups—This 64-pp manual on hook-ups for steam traps, air vents and temperature controls provides diagrams, size calculators, selection data on traps and regulators, properties of saturated steam, dimensions. Sarco Co., Inc.

220 Design Properties of Pipe—This 12-pp booklet consists of tables listing pipe sizes and wall thicknesses currently established as standard, plus what is believed to be the most nearly complete tabulation ever published of dimensional properties of commercial steel pipe. Tube Turns, Inc.

222 Handbook on Fittings, Flanges—Catalog wf-1950, 68 pp, offers working information on seamless carbon steel welding fittings and forged steel flanges. Includes dimensional tolerances, thread standards and threading practice; service pressure ratings, physical and chemical requirements. Grinnell Co., Inc.

223 Packless Expansion Joints—Bulletin 35-51A offers 28 pp of up-to-date information on company's Corruflex joints, their design and installation and advantages over other means of providing for thermal expansion in pipelines. Construction features are explained and illustrated; simplified selection data include tables for determining amount of expansion in pipelines. American District Steam Co., Inc.

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224 Piping Pointers—This is company's popular piping manual covering fundamentals of sound piping practices. Discusses various types of valve designs and how each should be used. Pictures and names more than 80 kinds of fittings and contains many illustrated how-to-do-it features. Included with the manual is an 8-pp valve selection guide. Crane Co.

225 Wrought Iron for Piping—This 32-pp booklet covers commonly used pipe materials and method of selecting them for specific types of service in modern building construction. Discusses wrought iron, cast iron and steel pipe, also copper and brass pipe, and the factors entering into the relative costs of piping materials. Pipe selection is treated, with emphasis on corrosion resistance. A. M. Byers Co.

LUBRICANTS, LUBRICATION

226 Lubricant Data Book—This pocket-size 56-pp booklet gives product information and principal uses of approximately 40 lubricants of both grease and fluid types, and general directions for proper application. Discusses lubricants requirements of equipment in 25 major industries. Lubriplate Div., Fiske Bros. Refining Co.

227 Versatile Industrial Oil—Described in 20-pp Form AD 4078 is an all-purpose oil offering protection for a wide range of industrial equipment, and available in 15 viscosity grades. Discusses six major characteristics of the oil, explains and pictures its use in hydraulic systems, speed reducers, air compressors, electric motors; hydraulic turbines, bearing systems, etc. A chart shows grades and uses, physical properties. Standard Oil Co. (Ind.)

229 Force Feed Lubricators—Twelve-pp Catalog 25 G describes and pictures company's new Model 25 lubricator, a popular priced, general purpose unit adaptable to many applications. Lists machines for which it provides economical, automatic lubrication. Discusses drive arrangements available, gives specifications, sizes. Manzel Div., Frontier Industries, Inc.

230 High Temp Lubrication—How "dag" colloidal graphite has been used successfully in various lubricating applications involving temperatures up to and over 2000 F is described in Bulletin 423. Acheson Colloids Co.

TOOLS, WELDING AND MACHINE SHOP EQUIPMENT

231 Pipe Tool Book—This catalog and data book gives information on pipe and bolt machines, power units, rachet threaders, reamers and cutters, other power and hand tools. Includes popular "operating guide" section, fully illustrated with easy-to-grasp drawings. Beaver Pipe Tools, Inc.

232 Portable Spray Gun—An easily used and inexpensive spray gun pressurized with a CO_2 cartridge is featured in this single sheet bulletin. Sketches show the gun in use for painting, cleaning, other work. Sullivan-Becker Machine Co.

233 For Faster Fastening—Form 35-A explains and illustrates company's system of fastening tools and fasteners for use with steel, wood, concrete, fabricated hard materials. Ramset Fastening System, Inc.

234 Pipe Tool Ordering Guide—Catalog 2-51, 8-pp, covers company's line of threaders, cutters, vises, dies, tongs and wrenches; gives prices. Armstrong Bros. Tool Co.

236 Hydraulic Pullers—Industrial maintenance problems involving removal and installation of gears, bearings, pulleys, sheaves, pinions, shafts, couplings, and tubes are treated in Power-Twin Bulletin HY-1953, 24 pp. Covers use and application of pullers, attachments and adaptors for 17½-, 30- and 50-t hydraulic rams. Also shows puller sets for use with company's center-hole rams. Owatonna Tool Co.

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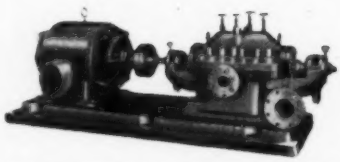

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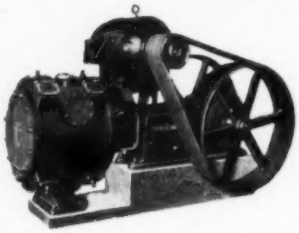

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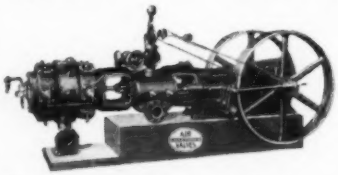

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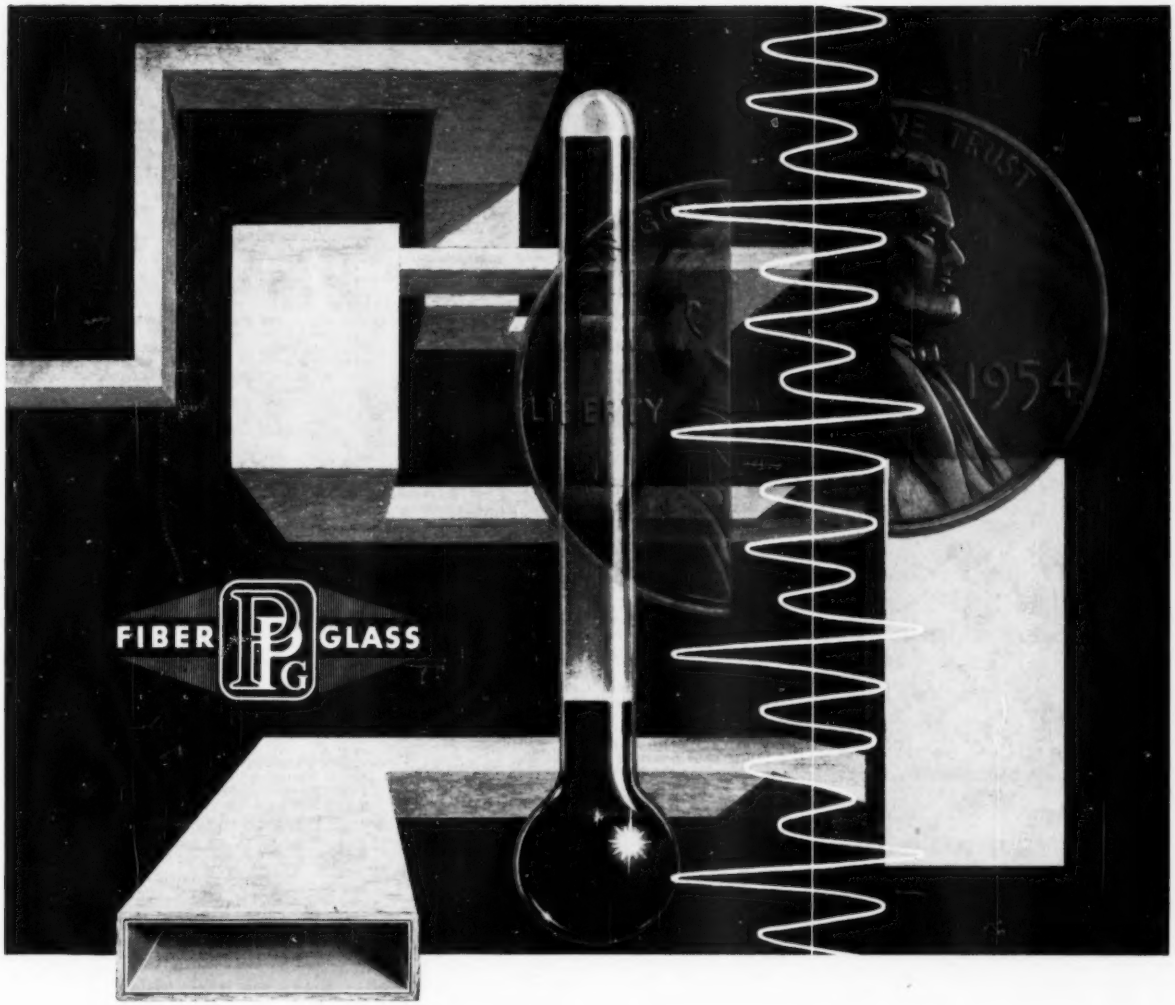

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237 Machine Tools, Their Lubrication—A h story of machine tools, an explanation of their mechanical aspects and an analysis of the role of lubricants in their maintenance and operation are contained in this 80-pp booklet. Not a manual on tool lubrication, this book is a comprehensive discussion of fundamental factors in the construction, operation and maintenance of modern machine tools. Shows how power is controlled and force directed to shape metal by cutting and chipping; analyses factors that contribute to friction and wear; and describes role of lubricants. Shell Oil Co.

ELECTRICAL, LIGHTING

238 Motor-Generator Reference Book—Publication 51R7933 is a 50-pp booklet compiled to assist in the selection of motive power to handle most industrial applications. Neither text book nor ordering catalog, this book provides a brief outline of the various types of motors, generators and motor-generator sets, telling their applications and operating requirements. Booklet is generously illustrated and includes performance data, ratings, information on methods of speed control. Allis-Chalmers Mfg. Co.

240 Motor Panorama—Motors and generators—about 50 types in all—are pictured in Publication AEB 100.8B, which serves as a handy reference, since it lists specific literature dealing with each motor shown. Gives general construction details of each unit. Fairbanks, Morse & Co.

242 Motor Handbook — Bulletin MU-185 provides 6 pp of engineering and descriptive data on motors, covering splash-proof and explosion-proof types, gear motors, motors for use in chemical plants, for oil well pumping, punch presses, elevators, cranes and hoists. Wagner Electric Corp.

243 Variable Speed Motors — Sixteen-pp Bulletin 1797, revised, outlines many reasons why variable speed motors can be used to improve production, and it includes illustrations of all types of company's Varidrive motors, as well as their mechanical features, remote controls, etc. U. S. Electrical Motors, Inc.

244 Productive Maintenance — Publication GED-1691 is a pocket-size 104-pp source of information of value to plant engineers who want to get more production from their present motors, generators and control equipment. Besides general maintenance suggestions, the book et contains trouble shooting charts and recommended renewal parts guides. Also provides wire and cable data and includes a section of formulas and other data pertaining to motors and generators. General Electric Co.

246 Bus Duct Manual—Booklet B-4272A 68 pp, on bus duct and accessories, presents application and test data, specifications, information on pricing a typical installation. Describes advantages of bus duct or a secondary power distribution system, carrying current from transformers to switchgear—and from there to motors, etc. Westinghouse Electric Corp.

247 Power Distribution Feeders—Catalog TEB-1, 40 pp, on heavy-duty units for main feeders in d'stribution system, gives construction engineering, application data. Trumbull Dept., General Electric Co.

248 Small Bus Duct—Detailed information on a midget-size bus duct is contained in Bulletin 703. Illustrates entire unit, also trap and hanger. Text discusses major parts, design features. Includes list prices. Frank Adam Electric Co.

249 Battery Technology Handbook—This is a 56-pp revised edition of company's manual of technical instruction and engineering data on the care of motive power storage batteries. Major addition is a section on charging, which includes information on modified constant voltage and two-rate charging, boost, equalizing and emerging charging, control of discharge, etc. Other sections cover the theory of the lead-acid battery; practical tips on care and operation; maintenance and repair. Gould-National Batteries, Inc.

250 What You Should Know About Circuit Beakers—Sixteen-pp Manual 101 explains operating principles of basic circuit breaker designs and provides engineering data on factors of application. Includes simplified diagrams of three basic types. Illustrates with colored charts and diagrams, explains temperature factors, inrush current effects, tripping and reset time. Heinemann Electric Co.

251 Preventive Maintenance Tips—Booklet B-5477, 28 pp, discusses programs designed to reduce shut-down time on production lines and treats in detail the maintenance of power equipment. A suggested schedule of work and cleaning on power equipment is presented in chart form. Essential information on preventive maintenance for turbines, generators, switchboards, motors and controls is given. Westinghouse Electric Corp.

252 Snap Action Switches—Catalog 82, 23 pp, on precision snap-action switches, presents safety, limit, and interlock types designed especially for switching a-c circuits in industrial applications. Covers heavy-duty lmit switches, metal enclosed switches, some of which are sealed against dirt, dust, splashing. Micro Div., Minneapolis-Honeywell Regulator Co.

253 Electrical Equipment for Cranes—A complete line of electrical equipment designed exclusively for crane service is presented in 32-pp Bulletin C5-1. Covers everything from company's a-c Magnetorque crane control to current collectors, and is generously illustrated. Overhead Crane Div., Harnischfeger Corp.

254 Flexible Cords—This well-illustrated 24-pp booklet includes all new Underwriters' classifications for flexible cords manufactured by this company. Featuring data on Dynaprene and rubber jacketed cords as well as braid covered types, also gives tips on how to select proper cord. Whitney Blake Co.

255 Cable Clips—Data sheets are available on cable supports made of ethyl cellulose designed to give excellent performance under ordinary service conditions. Information given covers properties of ethyl cellulose, sizes. Weckesser Co.

256 Selection Data on Lighting Fixture Hangers—Catalog 50, 80 pp, contains general and detailed information on disconnecting and lowering lighting fixture hangers, accessories, special devices and parts. Utilizes 247 photos and drawings to show construction principles, operating features, installations, modifications and component parts for both indoor and outdoor units. The Thompson Electric Co.

258 Lighting Fixtures—New Section K of Condulet Catalog 3000 describes components, performance data, and methods of relamping for any of the manufacturer's new EV series explosion-proof and weather resistant lighting fixtures. It contains illustrations showing steps for easiest relamping and installation of this type of fixture. Crouse-Hinds Co.

SANITATION

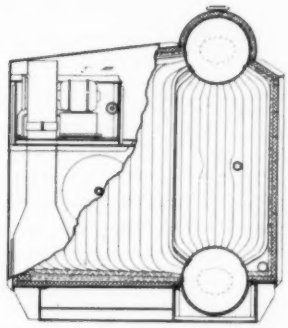
259 Advice on Washrooms—Information on company's washroom advisory service is available to plant engineers. Tells of plans and specific suggestions for improving washrooms which are included in this service. Scott Paper Co.

261 Hand Dryer—Form 1123 describes and pictures a high-speed hand and face dryer for use in industrial washrooms. Tells special features, gives specifications. The Chicago Hardware Foundry Co.

MATERIALS HANDLING

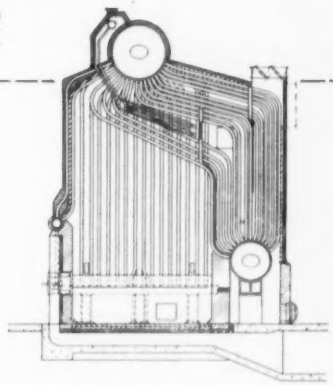
262 Data on Tramrail Equipment—Twelve-pp Form 2008F is a well organized booklet on tramrail systems. Tells what an installation can do toward improving handling efficiency. Rail and arch design, switches, cranes and transfer bridges, car-

THE C-E LINE OF STANDARD INDUSTRIAL BOILERS



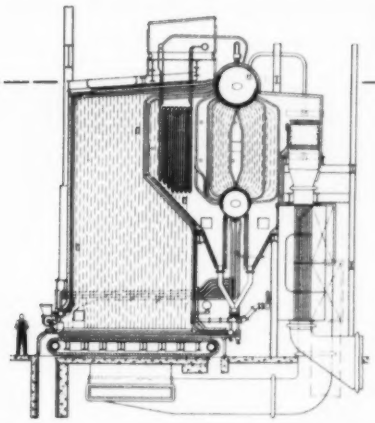
C-E Package Boiler—Type VP—The VP Boiler is designed to meet the demand for compact, standardized units in the medium pressure range. It is shipped completely shop-assembled, with firing equipment, fittings, and forced-draft fan. It is enclosed in a reinforced, welded steel, gas-tight casing. Arranged for pressure firing of oil or gas, the VP will burn either fuel exclusively or alternately. Designed for shipment by rail or truck, its width and height remain constant . . . variations are made in length only. Furnace is fully water-cooled, including burner wall, except in three smallest sizes. Large lower drum permits simple, symmetrical tube arrangement and greater water storage capacity.

Type VP Boiler—from 4,000 to 30,000 lb steam per hr . . . pressure to 250 psi . . . available for either gas or oil firing . . . fully shop-assembled.



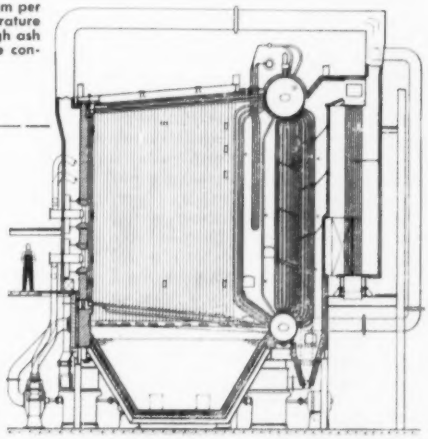
C-E Vertical-Unit Boiler—Type VU-10—Like the Type VP Package Boiler, the VU-10 is designed for plants having a limited number of operating and maintenance personnel. It is designed for industrial load conditions and will operate efficiently over a wide range of output. The boiler is bottom supported and has no outside supporting steel. The same general cross-section arrangement of drums, boiler convection bank, and furnace wall cooling is used when firing oil, gas or coal. Coal firing may be with underfeed, spreader, or chain grate stokers.

Type VU-10 Boiler—from 10,000 to 60,000 lb steam per hr . . . pressure to 475 psi . . . superheat to 200 F . . . suitable for any type of fuel.



C-E Vertical-Unit Boiler—Type VU-40—The VU-40 Boiler is a baffleless boiler designed for use with fuels having abrasive qualities in the flue dust. In a baffled boiler using these abrasive fuels, erosion is apt to occur. In the VU-40 Type Boiler, the eroding action of abrasives against boiler tubes and refractory is virtually eliminated. Like the VU-10 and VU-50, this unit is of symmetrical design, providing uniform gas flow and heat absorption across the full width of the boiler.

Type VU-40 Boiler—from 60,000 lb steam per hr up . . . pressure to 1375 psi . . . temperature to 960 F . . . for use with abrasive or high ash content fuel . . . indoor or outdoor type construction.



C-E Vertical-Unit Boiler—Type VU-50—With the VU-50 Boiler, the average plant can achieve standards of performance closely approaching those of large central power stations. The basic design was originated by Combustion in 1925 and has been widely accepted among steam-power engineers *everywhere*. Because of its symmetrical design the VU-50 provides uniformity of gas flow, water level and steam release across the full width of the unit. It may be fired by pulverized coal as shown opposite or by any other fuel or method of firing. Heat recovery equipment may be added.

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B-691

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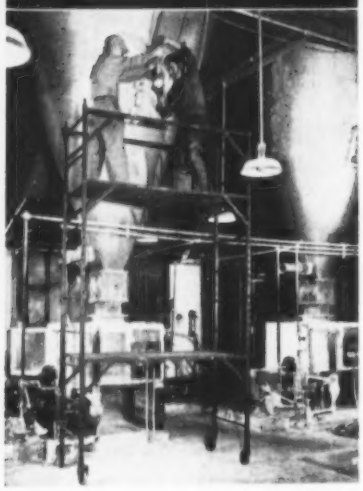

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DATA FILE

(Begins on page 151)

ries, hoists, cranes, buckets, grabs are pictured. Cleveland Tramrail Div., The Cleveland Crane & Engineering Co.

263 Engineered Monorail Applications—A file of application literature is announced as the beginning of a new service offered potential users of monorail equipment. Includes a technical booklet on automatic dispatch systems and an equipment bulletin in addition to several case studies of installations. As they are completed new groups of case studies will be sent to holders of file. Available to qualified plant engineers. The American MonoRail Co.

265 For Overhead Handling—This 12-pp illustrated catalog covers motorized and hand operated cranes and monorails engineered for efficient, low-cost handling. Special construction features are detailed; accessory equipment shown. Abell-Howe Co.

266 Tubular Conveyors — Form HC-541 contains about 44-pp of data on tubular conveyors for moving almost any flowable material. Shows basic types of these conveyors, tells what they're designed to do and how they are applied. Lists materials being handled to advantage with them, and discusses benefits. Gives engineering data. Hapman Conveyors, Inc.

267 Metal Conveyor Belts—This 24-pp booklet is an illustrated guide to selection of metal conveyor belts. Presents both conventional and balanced spiral weave belts; covers raised edge and flight constructions, chain edge construction, high temperature belts, wire conveyor aprons. Wickwire Spencer Steel Div., The Colorado Fuel & Iron Corp.

268 Fastenings for Conveyor Belts—This collection of data covers hinged fastenings, repair plates, lacings, hooks, round belt couplings, also lacers, cutters. Gives instructions for use. Armstrong-Bray & Co.

Postage-free Reader Service Cards make it easy to order any of this literature. See pages 35-36 and 149-150.

270 Conveyor Belting — Twelve types of conveyor belting, for standard heavy duty and special applications, are described in this bulletin. Pictures the beltings in use, and discusses in detail some of the impregnations and coatings utilized. Main Belting Co.

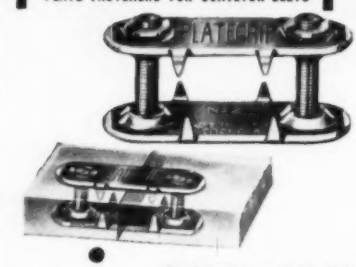
272 How to Pick a Truck—Catalog 54, 8 pp, features a step-by-step procedure for making the best fork truck choice for a particular handling job. Other sections in the booklet show at a glance complete specifications on each of company's trucks, and illustrate important construction and design features. The Baker-Raulang Co.

274 Safe Truck Operation — "Safety Saves!" is a 24-pp booklet setting forth "do's" and "don'ts" established as a practical code of truck operation. The admonitions pointed up by cartoons, serve as both "refresher course" and text. Industrial Truck Div., Clark Equipment Co.

275 How to Operate a Crane—Booklet 920 is a 48-pp generously illustrated instruction book on crane operation, helpful to both beginner and seasoned operator. It shows hand signals, defines crane and hoist terminology. Covering all phases of crane operation, it discusses in detail the co-ordination of crane motions and includes safety rules and inspection, maintenance tips. Individual copies of this book are free to qualified plant engineers. The Electric Controller & Mfg. Co.

277 Manual on Electric Hoists—Catalog H-46, 4 pp, covers monorail and stationary

PLATEGRIP
PLATE FASTENERS FOR CONVEYOR BELTS



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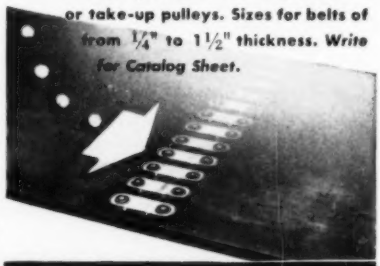

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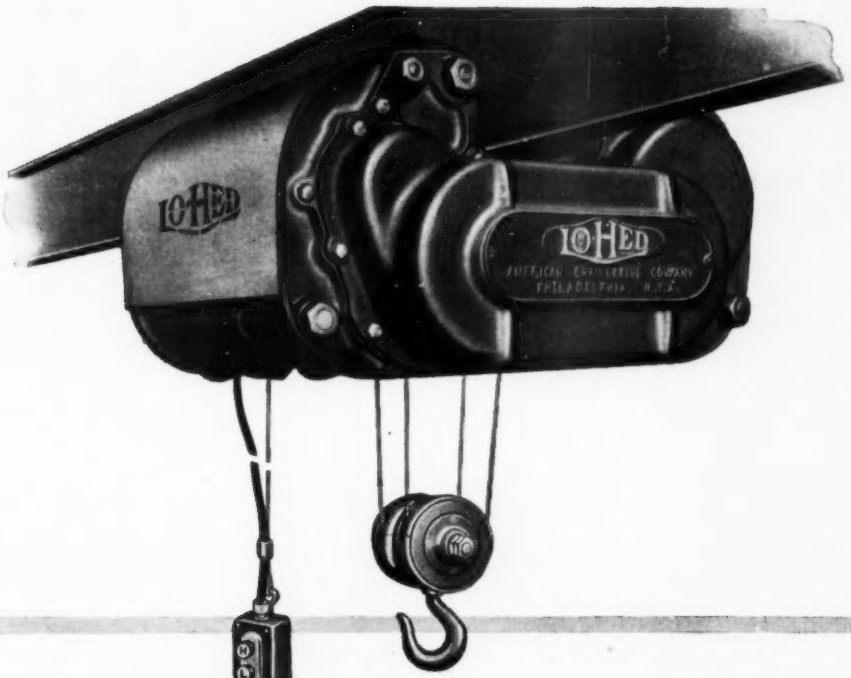

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DATA FILE

(Begins on page 151)

hoists and car pullies. Explains fundamental types of grabs, methods of hanging I-beams, types of hoist suspension, controls. American Engineering Co.

278 Electric Hoist Manual—Catalog 215-B offers 38 pp of engineering, application and ordering information on company's Load Lifter electric hoists. Presents hoists with hand operated trolleys and with power travel, hoists with lug suspension, hook suspension and push-type trolleys, and with hand-geared trolleys, hoists for low head. Manning, Maxwell & Moore, Inc.

279 Sheet Lifters—Operational and design features of company's sheet lifting equipment which contribute toward efficient handling, flexibility and economy are explained in Bulletin S-25, 16 pp. Cullen-Friestedt Co.

280 Shovel and Loader—Described in 12-pp Bulletin 1932 is a hydraulic crown and hoist shovel and loader incorporating mechanical features usually associated with big shovels. Illustrates, gives specifications, application information on both pneumatic traction and crawler traction models. Dempster Bros., Inc.

281 Trolley Hoists—Bulletin DH-269, 2 pp, describes and pictures ½ to 3 t capacity army-type trolley hoists, plain or geared, for use where a close headroom assembly is required. Gives dimensional and capacity data, prices. Wright Hoist Div., American Chain & Cable Co., Inc.

282 Lightweight Hoists—Sixteen-pp Bulletin 182 describes the Liftabout Jr. line of lightweight electric hoists — compact, planetary gear, wire rope type hoists designed for intermittent duty, built in capacities of 250 to 2000 lb. Gives details of construction, clearance dimensions, mechanical and electrical features. Shepard Niles Crane & Hoist Corp.

MAGNETIC EQUIPMENT

283 Magnets in Stock—A complete listing of stocked sizes and shapes of Carboloy Alnico permanent magnets is provided in 20-pp Bulletin PM-100. Contains pull curve and size information in tabular form on both cast and sintered types, as well as sizes and application data on holding assemblies, including sheet steel separators, magnetic retrievers and stands. A list of available patterns for various sizes of cast Alnico bars, etc. is included. Carboloy Dept., General Electric Co.

285 Magnetic Selection Guide—Twelve-pp illustrated Catalog C-5000-B, describing manufacturer's entire line of magnetic separators and lighting magnets, serves as handy guide to the selection of magnets. Dings Magnetic Separator Co.

MECHANICAL POWER TRANSMISSION

286 Variable Speed Control Simplified—Bulletin 700 contains some 40 pp of descriptive application and engineering data on variable speed pulleys and selective speed transmissions. Illustrations show how old and new machines can be equipped with efficient variable speed control. Lovejoy Flexible Coupling Co.

287 Improved V-Belts—This literature on company's Vulco rope drives explains how this rope with concave sides is designed to fill out to a precise fit in the sheave groove, to provide less wear, more pulley contact and more sure power when needed. The Gates Rubber Co.

289 Power Drive Handbook—Catalog 709, describing roller chains and sprockets, includes tips on selecting stock roller chains for every type of power drive service. Diamond Chain Co., Inc.

291 Belts to Suit the Job—This bulletin presents company's "inner-locked" woven

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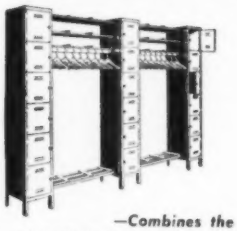

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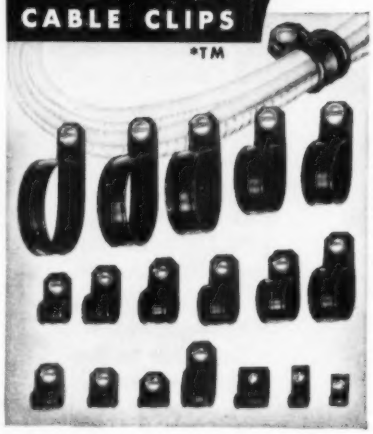

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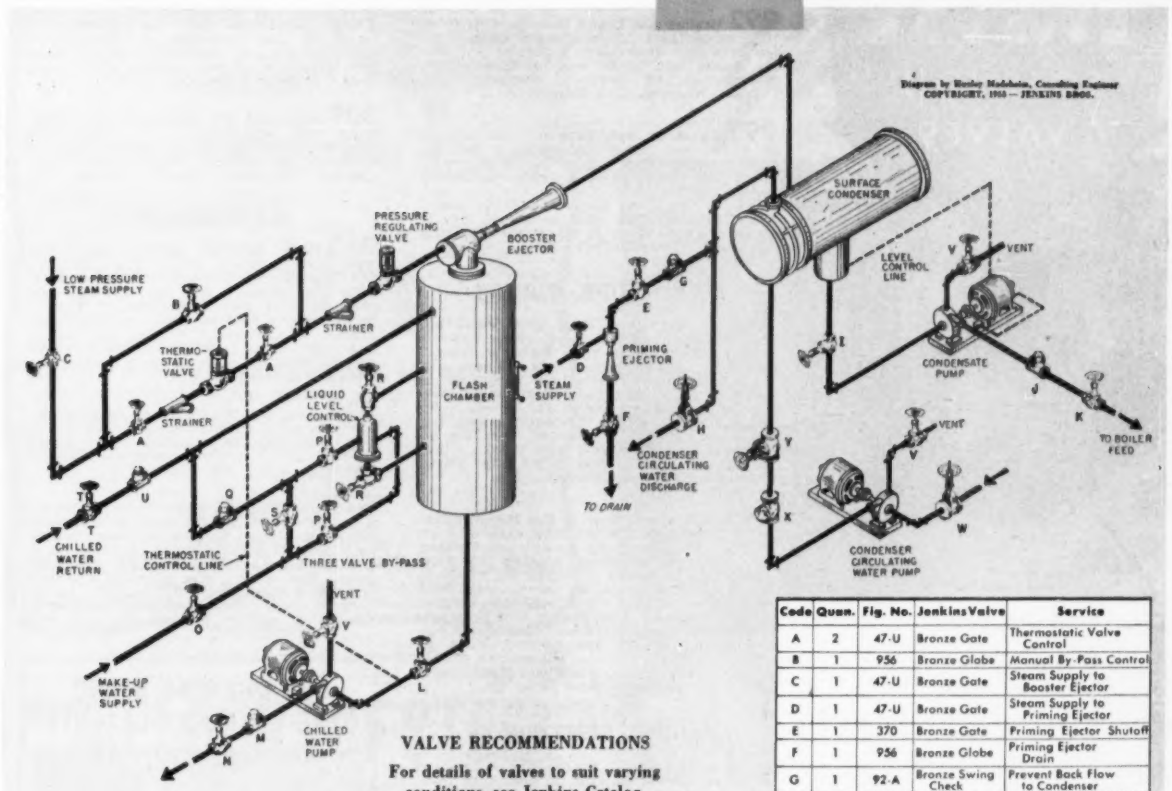

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E	1	370	Bronze Gate	Priming Ejector Shutoff
F	1	956	Bronze Globe	Priming Ejector Drain
G	1	92-A	Bronze Swing Check	Prevent Back Flow to Condenser
H	1	651-A	I.B.B.M. Gate	Cooling Water Discharge Shutoff
I	1	370	Bronze Gate	Condensate Pump Shutdown
J	1	92-A	Bronze Swing Check	Prevent Backflow through Condensate Pump
K	1	106-A	Bronze Globe	Condensate Pump Control
L	1	370	Bronze Gate	Chilled Water Pump Shutdown
M	1	92-A	Bronze Swing Check	Prevent Back Flow Through Pump
N	1	106-A	Bronze Globe	Chilled Water Pump Control
O	1	106-A	Bronze Globe	Make-up Water Control
P	2	370	Bronze Gate	Automatic Valve By-Pass
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R	2	108-A	Bronze Angle	Level Control Shutoff
S	1	106-A	Bronze Globe	Manual By-Pass Control
T	1	106-A	Bronze Globe	Chilled Water Control
U	1	92-A	Bronze Swing Check	Prevent Backflow Chilled Water Lines
V	1	106-A	Bronze Globe	Pump Vent
W	1	651-A	I.B.B.M. Gate	Condensing Water Pump Shutdown
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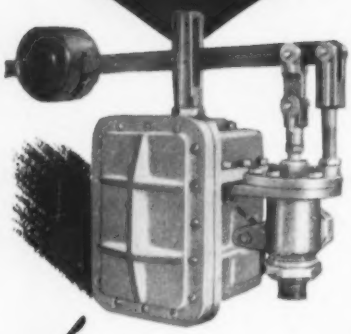

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Davis
DAVIS REGULATOR COMPANY
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DATA FILE

(Begins on page 151)

duck belting available in types for general elevating and conveying and general power transmission applications as well as special jobs. Imperial Belting Co.

292 Brakes and Brake Motors—Construction advantages of company's brakes are featured in illustrated Bulletin SL-610-1 on brakes and brake motors. Dimensions, mechanical and electrical characteristics. Crocker-Wheeler Div., Elliott Co.

293 Chart on Belt Care—In the interest of conserving power transmission belting, this manufacturer offers cardboard wall chart on the care and maintenance of power driven belts. Carries sketches and brief text covering the steps to be taken to select the right belt, install it, use it correctly and keep it in good operating condition. Cling-Surface Co.

WIRE ROPE, SLINGS

294 To Keep Wire Rope at Work—Form 3547 is an 82-pp handbook titled "Here's How to Keep Your Wire Rope Working," and filled with practical tips on care and use of wire rope. Tells how wire rope is constructed, what types are suited to various jobs, how to install it. Covers such subjects as abrasion, lubrication, avoiding kinks, alignment of sheaves, winding on drums, bending fatigue, wire breaks, when to discard a wire rope. Wire Rope Divs., American Chain & Cable Co., Inc.

296 Wire Rope, How to Use It—Practical information on the use and care of wire rope is given in 72-pp pocket-size Catalog C-51. Covers unloading, storing, kinking, unreeling, installing, breaking in, methods of seizing and cutting, measuring, end preparations, many other pertinent factors. Fully illustrated with photos and sketches, treats splicing in detail and includes chapter on lubrication. Also presents data on wire rope constructions, efficiencies of fittings. Available to qualified plant engineers. A. Leschen & Sons Rope Co.

DUST CONTROL

298 Dust Control Technology — Detailed selection, operation and maintenance data are contained in this 50-pp digest-size book, "Industrial Dust Control Through Exhaust Systems." Treats exhaust hoods, piping systems, dust collecting equipment, exhausters and drives. Lists basic methods of dust control and analyzes elements of exhaust systems. Pangborn Corp.

300 Manual of Exhaust Hood Design—Bulletin 270-E1, 24 pp, features engineering data on dust control systems for the metal working industries. Illustrates and discusses the design of exhaust hoods for many operations in this field. Also, 61 photos of dust control installations show various methods of hooding dust sources. American Air Filter Co., Inc.

301 Dust Control—Bulletin 98 explains value of industrial dust control and principles of dust suppression, collection by filtration. Describes dust control equipment, providing specifications, dimensions on filters, systems, automatic controls. The W. W. Sly Mfg. Co.

303 Dust Control—"Engineered Efficiency in Dust Collection and Recovery," 36 pp, discusses industrial dust recovery from standpoint of nuisance abatement, waste avoidance, hazard elimination. Shows effect of variation in particle size distribution and specific gravity of dust on efficiency of the dust collecting system. Buell Engineering Co., Inc.

VENTILATING AND AIR CONDITIONING

305 Putting Air to Work—Catalog 600 is an excellent, 60-pp reference text on air and products to put it to work. For plant engineers concerned with heating and ventilating of plant areas; air conditioning installations; means of exhausting fumes, gases and dusts; conveying chips and granular materials; elimination of airborne dirt — this book is a valuable tool. It's packed with information on selecting and applying equipment, and there is a section of frequently-used reference data. Sturtevant Div., Westinghouse Electric Corp.

307 Air Conditioning Cabinets — Engineering Bulletin 3703A, 40 pp, describes and illustrates manufacturer's Model G cabinets, central units available in both horizontal and vertical models, providing 875 to 22,000 cfm and offering combinations for any function or functions of air conditioning. Booklet gives construction details, discusses heating and cooling coils. Buffalo Forge Co.

309 Improved Air Conditioning—Advantages and applications of a controlled humidity method of air conditioning are discussed in Bulletin 112. Process is explained, illustrated. Niagara Blower Co.

MAINTENANCE

310 Basic Roofing Information—"What You Should Know About Your Roof" is a 40-pp, clearly illustrated booklet which tells what makes a roof fail, how to recognize signs of roof deterioration, what to do to keep a roof in good condition. Discusses recommended roofing practices, essentials of a good re-roofing job, also special features of company's roofing materials. Johns-Manville.

312 Building Maintenance—Handbook 7 offers 64 pp of information on floor surfacing, leak stoppers, external wall sealants, road patching, roofing materials. Includes instructions for use. Flexrock Co.

314 Tar Base Coatings—Now available is a collection of five bulletins on company's 100 series of cold applied tar base coatings. One bulletin gives general information on the full line and provides an application chart. The others give detailed specifications and application information on the various types. These include a coating for protection against severest corrosive con-

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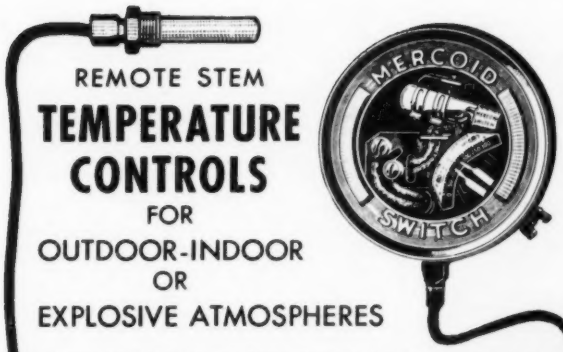

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Mercoid Remote Stem Temperature Controls are available in ranges varying from minus 30°F. to plus 60°F. to 370-530°F. in the sensitivity and circuit arrangement your application requires.

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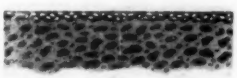
STEEL-CLAD OR IRON CHIP SEEDED



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resist more cutting abrasion than any other conveyor belting on the market.

In fact, an axe dropped on an ARMADILLO belt, as illustrated, will not penetrate the coating.

This tough, glass-like yet flexible belt withstands cutting abrasion and actually sheds oil . . . of any kind . . . of any quantity. ARMADILLO is ideal for conveying oily steel scrap, metal tote pans, sharp-edged stampings, artillery shells, etc.

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use a C-F SHEET LIFTER

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Up to 10,000 lbs. of high grade sheets in varying widths may be picked up, carried and unloaded at shears or machines with speed and economy by the Lifter and its operator.

C-F Lifters are made in standard or semi-special models to handle from 2 to 60 tons. Bulletin SL-28 describes the advantages you can obtain from C-F Lifters. Write for it today.

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DATA FILE

(Begins on page 151)

ditions; a thin high gloss coating for general maintenance purposes; a coating for protection against generally severe corrosive conditions; and one for water tank interiors. Pittsburgh Coke & Chemical Co.

316 Coatings for Chemical Industry — Advantages and use of synthetic resin-base coatings in the chemical industry are described in this 8-pp brochure. Presents 16 industrial case histories. Specific applications of coatings based on Bakelite and Vinylite resins described include tank cars, oil pipe, acid tanks, sewage disposal plant, shipping containers, plating rack and steel tubing. Also included is tabulation of effects of various chemicals on vinyl resin-base coatings. Bakelite Co., Div., Union Carbide and Carbon Corp.

318 Iron Cement Handbook — This is a 40-pp pocket-size catalog of iron cements for repair, other uses. Tells how to mix and apply them. Gives illustrated instructions for dozens of repair and maintenance jobs. Smooth-On Mfg. Co.

320 Proper Care of Floors—Filled with what-to-use and how-to-use-it information, this 32-pp booklet is a well written, practical text on floors. Presents floor preservation as a triple process involving cleaning, sealing and maintaining. Discusses various floor surfaces and their special problems. Gives helpful hints on floor maintenance and provides a handy chart covering preparation procedures and products for 12 common floor surfaces including cement, work, tile, linoleum, mastic wood. West Disinfecting Co.

322 For the Overhead Jobs — Scaffolds designed to make overhead work safer and easier are described in 16-pp Form 10-852. Illustrates and discusses adjustability, large working platform, easy assembly, self-locking trusses and other advantages. Shows how they are readily stacked for height. Baker-Roos, Inc.

CONSTRUCTION

324 Glass Block Fenestration—The natural ventilation characteristics of glass block fenestration are presented in this illustrated report of a test project. In some 88 pages, report covers sun hoods, window types, dual outlets, air speeds, double loaded variations, reverse draft and ventilation below window sill. Test data is summarized and recommendations included. Although test was conducted on glass block fenestration in school buildings, the information will be of interest to those concerned with industrial applications of glass block. Kimble Glass Co.

326 Heat Absorbing Glass—This 16-pp catalog describes Coolite, a glass designed to trap and absorb much of the sun's heat and to filter out annoying glare. Discusses types and thicknesses, gives light transmission data. Pictures many industrial installations and shows how conditioned natural illumination helps reduce operating costs. Mississippi Glass Co.

328 Translucent Structural Panels—Bulletin 533, 12 pp, describes Resolite, a translucent structural material, corrugated or flat, molded of thermosetting polyester resins reinforced with woven glass fibers. Illustrates use of Resolite in partitioning, skylighting and decorating installations. Provides standard sheet specifications, general information on colors, weights, light transmission and thicknesses. Resolite Corp.

330 How Hardboards Improve Methods—Twelve-pp Form 5202, on production economies in plant maintenance, materials handling and processing, enumerates applications and specifies types and thicknesses of company's Presdwood for specific purposes. Lists 28 advantages of Presdwood, describes its use in architectural applications, bins, utility boards, cabinetwork, containers, booths and ventilators, work surfaces. Masonite Corp.

331 Technical Manual on Plywood—Available basic data on Douglas fir ply-

"Get Out From Under-"

Federal "J" Siren cuts through high noise levels to save lives!

You never know when a cable might break or a load might shift. Unless warned, workers on the craneway face swift falling death from above.

Shouting won't do it, nor will an ordinary signal. You need a powerful, distinctively high-pitched Federal "J" siren . . . a siren that overcomes intensely high noise levels. The Federal "J" is a heavy duty siren specifically designed for electric cranes and operating long periods of time repeated 24 hours a day. Where heavy duty, high-frequency of operation is necessary — where distinctive, penetrating sound protection can save lives — install a Federal "J" siren.

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a lump or thickening

...in the breast or elsewhere —is the second of the seven commonest danger signals that *may* mean cancer...but should *always* mean a visit to your doctor.

The other six danger signals are— 1 Any sore that does not heal 3 Unusual bleeding or discharge 4 Any change in a wart or mole 5 Persistent indigestion or difficulty in swallowing 6 Persistent hoarseness or cough 7 Any change in normal bowel habits.

For other facts about cancer that may some day save your life, phone the American Cancer Society office nearest you, or write to "Cancer"—in care of your local Post Office.

American Cancer Society

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Also, Fabri-Valves cost less, weigh less, are easier to maintain and more economical to ship and install. 2″ to 24″ Fabri-Valves carried in stock . . . custom-made orders filled in 30 days. Write or call your nearest dealer for complete details on how Fabri-Valves can reduce your maintenance cost.

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New 50 Ton CENTER-HOLE Hydraulic Puller

Removes or installs bearings, gears, pinions, shafts, studs, wheels, pulleys, etc. — 75% faster and 90% easier without damage or distortion. This new OTC 50 ton ram is completely portable (weighs only 45 lbs.) — has remote control pump — interchangeable ram heads — and can be used as a production holding fixture. Also available in 17½ and 30 ton sizes.

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Booklet describes complete line and uses of OTC tools.

OWATONNA TOOL COMPANY

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DATA FILE

(Begins on page 151)

wood, its properties and use, are offered in looseleaf sections with firm binder. Presents engineering information about this panel material and its performance in varying applications. Covers commercial standards, designing with plywood, prevention of condensation, lateral bearing strength of nailed plywood joints, deflection. Please give your title when requesting this book. Douglas Fir Plywood Assn.

333 Industrial Layout Tapes—This 6-pp brochure describes a variety of pressure-sensitive tapes representing conveyors, structural components, etc., scaled ¼ in. to the foot. Other tapes in the line consist of lines, reference numbers and letters and colored arrows. Layout boards and grid sheets also listed. Chart-Pak, Inc.

334 Where to Use Your Stud Driver—Twenty-pp pocket-size Form 955 describes and pictures applications of studs, using company's Model 450 stud driver. Provides some operating hints and safety precau-

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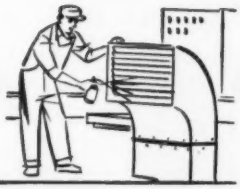

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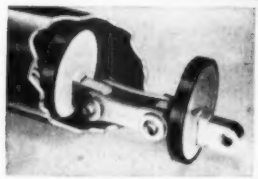

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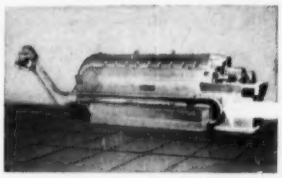
You can get low-cost, *automatic chip, dust or sludge removal* on new machines of many types by *specifying Hapman Conveyors* as original equipment. We cooperate with the tool builder.



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Shop Supt. says magnets " . . . *prove very successful for holding parts during stroke of press*" in piercing die operation.

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They find the powerful, lasting energy of the magnets ideal for holding, lifting and separating jobs . . . for speeding setups, production . . . for saving time, money plantwide.

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Identify grade of stainless steel.

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Shop Package No. 1 – Contains 48 Carboloy permanent magnets: 8 styles – 3 pairs each. Magnetic pull up to 2 lbs. per magnet. Price $10.00 (subject to applicable sales and use taxes). Order today.

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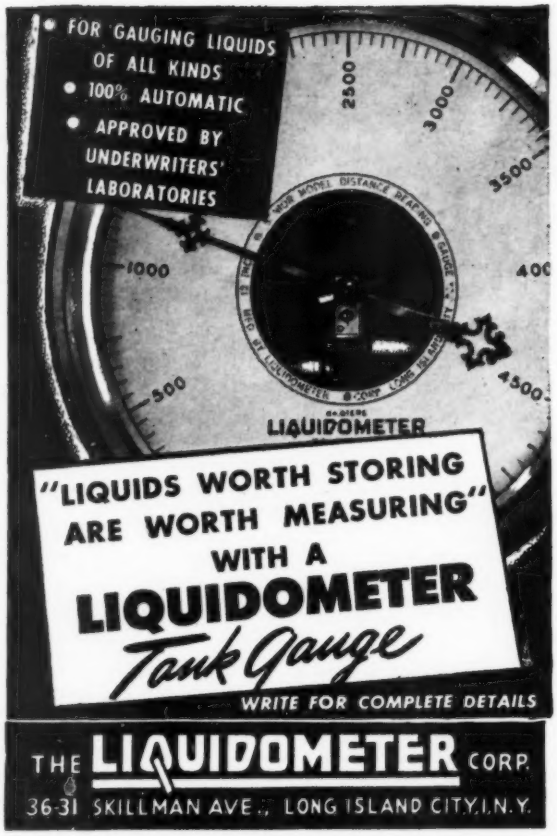
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DATA FILE

(Begins on page 151)

tions and covers use of studs through steel into concrete, wood into concrete, wood into steel and steel into steel, as well as their use for attachment of predrilled fixtures. Remington Arms Co., Inc.

PUMPS, COMPRESSORS

336 Pump Service Manual—Bulletin 202 is a 20-pp booklet covering installation, operation and maintenance of manufacturer's reciprocating pumps and providing helpful engineering information. Suction piping, valves and accessories for proper operation are discussed. Sectional drawings and parts lists are provided, also high and low capacity steam consumption curves, general information on water, properties of steam. Warren Steam Pump Co., Inc.

338 How to Solve Pumping Problems—A new printing of this popular 36-pp booklet makes it again available to plant engineers. Filled with helpful technical information, explains design and operation of rotary gear pumps and discusses factors of pumping problems, covering some sample ones in detail. Illustrated, provides friction loss and conversion tables, electrical data, viscosities of liquids, construction materials for handling various liquids, resistance of valves and fittings to flow of fluids. Geo. D. Roper Corp.

340 Condensed Pump Data—Form 4383-J covers more than 20 types of general service pumps, rotary pumps, sump and drainage pumps, condensate units, self-priming units, stainless steel pumps and high pressure pumps. In easy-to-find tabular form, each model is pictured along with its characteristics, applications, and features. Goulds Pumps, Inc.

342 Data on Pumps—This 12-pp condensed catalog covers turbine-type and centrifugal pumps for a wide range of industrial uses. Gives construction specifications, capacities, application information as well as reference to specific literature on each type. Fully illustrated. Also includes data on mixed flow pumps, sump pumps. Aurora Pump Co.

344 Centrifugal Compressors—Twelve-pp Bulletin 109 describes and pictures single-stage centrifugal compressors for delivering large capacities of pulsation-free air or gases. Their functions, applications, ratings, construction features, arrangements and methods of control are presented. American Blower Corp.

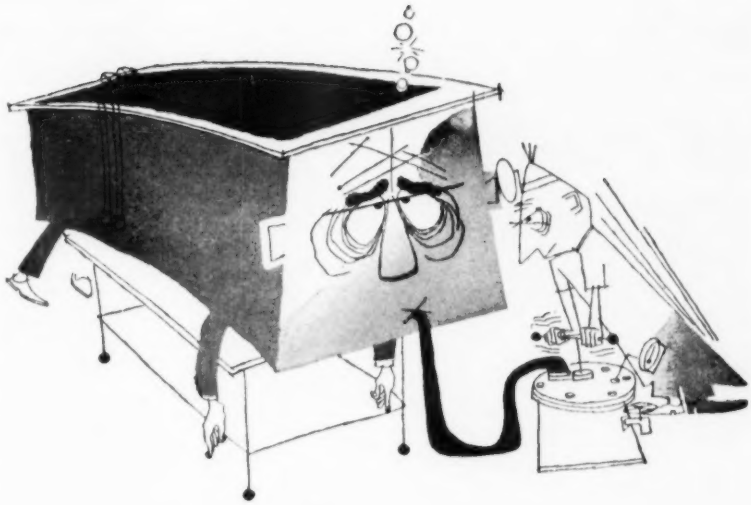
346 Compressors, Pumps—Catalog 546, 6 pp, presents company's line of air and gas compressors, Oilfreair and Oilfregas compressors, dry vacuum pumps, aftercoolers, Airchek valves, and centrifugal pumps for boiler feeding and general applications. Includes brief descriptive data. Pennsylvania Pump and Compressor Co.

HEATERS, HEATING

347 Faster Tank Heating, Cooling—Bulletin IP-250, 8 pp, describes company's Platecoils, embossed metal sheets welded to form compact units through which required heating, or cooling, medium is circulated under pressure. Explains lower costs, faster tank cooling or heating, lighter weight of the units. Kold-Hold Mfg. Co.

348 Buying a Portable Heater?—Stressing safety factors involved, this 40-pp booklet, "Guide to the Selection and Use of Portable Space Heaters," analyzes temporary heating equipment from standpoints of personnel well being, property protection and fire and accident prevention. Classifies basic types of direct- and indirect-fired portable heating devices, giving their advantages and limitations. Provides a guide for evaluating portable heaters in terms of design, construction, operation and safety. Herman Nelson Div., American Air Filter Co., Inc.

349 What Unit Heaters Can Do—Featuring many photos showing how unit heaters are being used to provide heating comfort.



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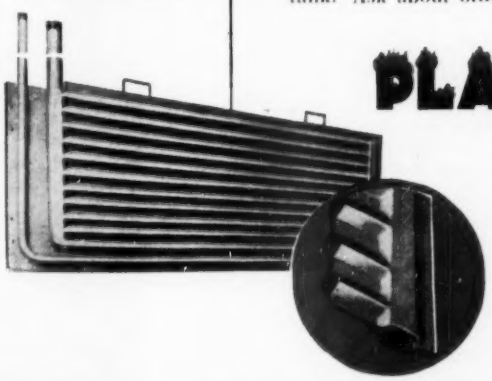

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DATA FILE

(Begins on page 151)

cut fuel costs, provide economical air circulation, 8-pp Bulletin 149-A discusses advantages of these heaters and gives performance data. Modine Mfg. Co.

350 Engineering Data for Heating Systems—A great deal of helpful information on heating systems is presented in Engineering Data Manual 2695, 28 pp. Detailed, illustrated information pertaining to heating problems is given. Besides covering heating terminology, there are sections on steam data, water properties, piping data, weights and measures and pipe dimensions. C. A. Dunham Co.

351 Electric Heaters—Bulletin E-1, 8 pp, describes electric unit heaters and heater sections for general industrial heating as well as for specialized use in heating corners of factories, warehouses. Illustrates overhead downward discharge heaters with revolving and stationary discharge outlets and a heater with horizontal discharge. An electric duct heater section is also described. L. J. Wing Mfg. Co.

353 Forced Air Space Heaters—Illustrated Bulletin 523-B, 12 pp, is devoted to a line of forced air heaters for comfort heating, year-round ventilating, tempering make-up air, process drying and heat curing. Explains design efficiency, construction details, operating principle and flexibility of application. Advantages of the heaters are detailed. Dravo Corp.

BOILERS, GENERATORS

355 Packaged Boilers—This 16-pp illustrated catalog describes manufacturer's new type VP package boiler. Following a section of background information is an outline of principal design features of these boilers, which are shop assembled and provide steam capacities from 4000 to 30,000 lb per hour. Space requirements are shown in a table along with typical specifications. Combustion Engineering, Inc.

357 Shop-Assembled Boiler—Sixteen-pp Bulletin G-76, completely describes and illustrates company's Type FM water-tube integral-furnace boiler, made in standard sizes from 2900 to 28,000 lb of steam per hr, pressure to 250 psi. Capacities, dimensions given. The Babcock & Wilcox Co.

OTHER EQUIPMENT

359 Plumbing, Heating Supplies—Edition G is the current edition of this company's 118-pp general catalog on plumbing and heating repair parts, tools and accessories. Indexed and generously illustrated, gives sizes, intended uses and necessary ordering information. J. A. Sexauer Mfg. Co., Inc.

361 Industrial Leathers—These illustrated data sheets cover company's leather products and include specifications on various types of leather belting. Also give data on leather packings for hydraulic and pneumatic equipment. J. E. Rhoads & Sons.

363 Standardized Spray Booths—Literature is available on water wash, dry type, bench or leg type spray booths, based on standard panel sizes. Stresses easy erection, lower costs. The DeVilbiss Co.

365 Engineered Vibration Control—Bulletin 104 presents spring, cork and rubber mountings, discusses advantages of each and use alone or in combination. Provides helpful selection chart covering a wide range of machines, showing recommended and alternate methods of isolation. The Korfund Co.

366 Hints on Babbitting Practice—In outlining basic steps for the prevention of common bearing failures, Bulletin 146, a little 16-pp booklet, covers everything from the choice of metal for a particular bearing application through the correct pouring practice to in-service maintenance. Proper lubrication, a maintenance schedule, and operation at correct speed are discussed. Federated Metals Div., American Smelting and Refining Co.

367 Good Place for Wraps—Manufacturer's Lockerettes, modern scientific locker units combining best features of both lockers and coat racks are described and pictured in Bulletin 658. Vogel-Peterson Co.

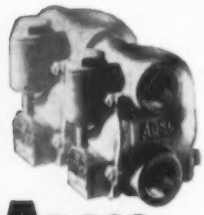
368 Finishing Systems—Illustrated Catalog A-653, 12 pp, describes complete finishing systems for porcelain and synthetic enamel, lacquer, paint, and other finishing. Also covers a variety of other industrial equipment including ovens, dust collectors and fog filters, metal cleaning and pickling equipment. The R. C. Mahon Co.

369 Hydraulic Hose Selector—The Wiretex rubber covered hydraulic hose selector is offered to users of hydraulic control hose. Starting with any known factor—the ID, OD, minimum burst working pressure required etc.—a plant engineer can use the selector to determine the proper hose for the job. Republic Rubber Div., Lee Rubber & Tire Corp.

370 Socket Head Fasteners—Advantages of company's screw products are described in this folder. Included are socket head cap screws, shoulder screws, flat head socket cap screws and button head socket screws. Also described are socket screw keys, square head set screws, pressure plug and dowel pin. Standard Pressed Steel Co.

371 Buyer's Guide on Packings—Twenty-pp Catalog PC-101 brings together all material on company's Palmetto packings and includes data on packing for liquid pistons on inside-packed piston pumps. Greene, Tweed & Co.

372 Neoprene Design Book—This illustrated bulletin discusses the properties of Neoprene, showing how they are utilized in products made from this chemical rub-



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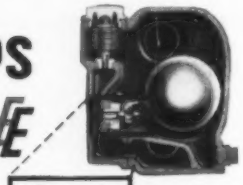

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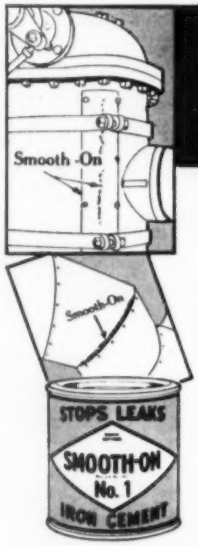

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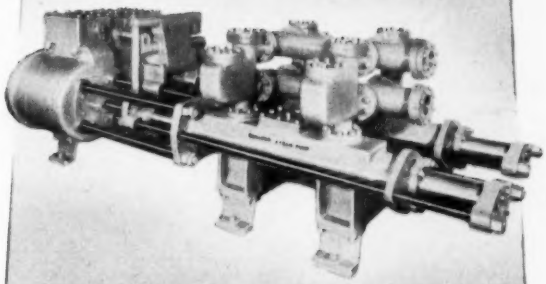

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(Begins on page 151)

ber. Covers its toughness, hardness range, air retention, performance under load, at extreme temperatures, flame and chemical resistance. Rubber Chemicals Div., E. I. du Pont de Nemours & Co.

373 Hydraulic Cylinders—Bulletin 701, 28 pp, presents a line of hydraulic cylinders offering dependability and ruggedness. Explains design advantages of the line and gives mounting data and capacities of cylinders for working pressures up to 1500 psi and those for working pressures to 3000 psi. Lindberg Engineering Co.

374 Dust and Fume Eliminators—Catalog 482, 12 pp, describes company's Centri-Merge dust and fume eliminators, explaining advantages of the swirl action incorporated. Illustrations include photos of installations, and dimensional drawings of units with capacities ranging from 400 cfm up to 5000 to 30,000 cfm. Schmieg Industries, Inc.

375 Hard Surfacing Directory—Bulletin 466, 20 pp, is newest edition of company's popular Weldirectory for hardsurfacing. Provides a detailed discussion of arc weld surfacing and a chart showing basic differences between types of materials to help user choose the one best suited to his requirements. This guide covers properties, weld size, cost and electrode size. Application data is given on various electrodes, also hardsurfacing fluxes. A bibliography of recommended texts on arc welding is given. The Lincoln Electric Co.

376 Industrial Truck Reference Guide—Bulletin 300, 44 pp, covers company's line of current model tractors, trailers, fork lift trucks, platform lift trucks and load-carrying trucks. Major categories are: the trackless-train system; the fork-truck pallet system; and the lift truck-skid system. Each category is preceded by an analysis of applications and merits of the handling system. Mercury Mfg Co.

377 Welding Fittings—Catalog 3 is a 36-pp ordering and engineering reference book on company's Weldolets for piping services. Gives data on butt-welding and socket welding Weldolets as well as on Thredolets for making threaded outlets. Typical installations are pictured; sizes, weights and prices provided. Also included are installation instructions and a technical section covering material specifications. Bonney Forge & Tool Works.

Postage free cards for ordering these catalogs are on pages 35 and 149. When using them, don't forget to include your job title and company name—even if you want those catalogs to be delivered to your home address

378 Industrial Steel Windows—Planned to offer comprehensive easy-to-find data, this 24-pp catalog gives descriptions, specifications, sizes, uses and advantages of Fenestra pivoted windows, commercial projected windows, and security windows used separately and in combination, also continuous windows used mainly for top-lighting in monitor and sawtooth roof construction. Detroit Steel Products Co.

379 Sling Handbook and Riggers Manual—In the sling handbook section of this 48-pp book, 11 sling types are illustrated and their dimensions, weights and safe working loads given. Illustrations of sling uses accompany factual data. Also pictured and detailed are sling fittings. Information on care of slings, data on braided wire fabric and directions on splicing braided wire sling fabric included. The riggers manual gives detailed instruction on splicing, and includes data on efficiencies of wire rope attachments and directions for attaching sockets or ferrules. Shows signals for cranes. Union Wire Rope Co.

380 Industrial Motors—Twelve-pp Brochure 100 gives information on company's line of industrial motors. Construction details are discussed and drip-proof, splash-proof, totally enclosed and other types described and illustrated. Mechanical and electrical modifications possible are detailed and selection data included. Motor generator sets, brake motors, elevator hoist motors are shown. Electro Dynamics Div., General Dynamics Corp.

381 Maintenance Manual — "Over the Rough Spots" is a 48-pp pocket size booklet giving the answer to practically every repair or building maintenance problem. Tells how to patch holes and resurface floors, how to prevent water seepage in underground foundations, repair leaky roofs, preserve concrete or wood surfaces, protect structural steel from rusting, and gives many time and labor saving methods. Generously illustrated. Stonhard Co.

382 Sprockets, Roller Chain — Bulletin A-624, 24 pp, is compiled to provide plant engineers with all data required for selecting and ordering roller chain and sprockets. A page devoted to Taper-Lock sprockets for each size of chain from 40 to 100, giving sectional drawing, dimensions, number of teeth, maximum stock bore available, weights, prices and other data. Another page covers Taper Lock bushings; and full information is given on riveted and cottered-type roller chains. Dodge Mfg. Co.

383 Air Conditioning Book, Heating — Bulletin PB-290, 36 pp, is a complete, condensed catalog covering company's full line of air conditioning, heating, ventilating and heat transfer equipment. Supplements some 40 specialized bulletins on various product lines. The Trane Co.

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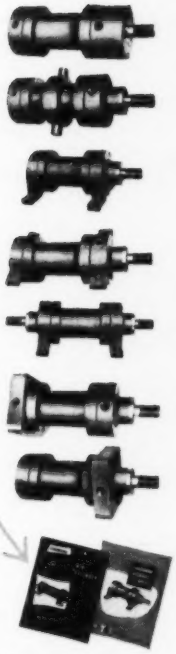

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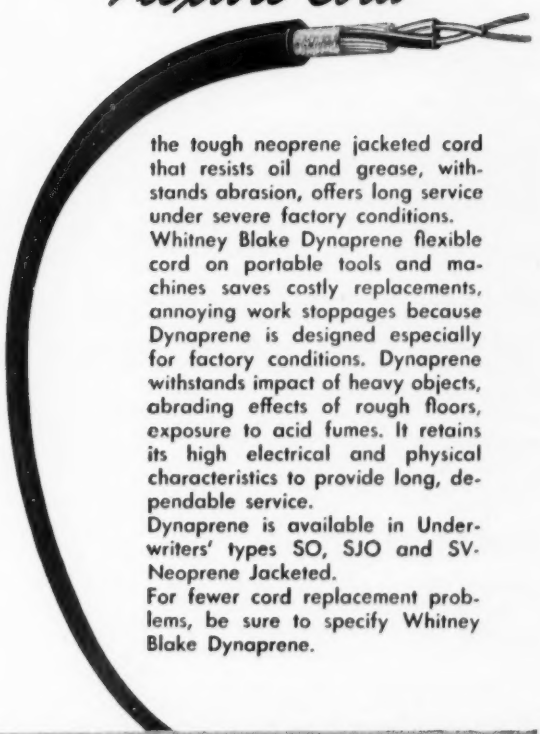

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To assure the constant tension which is an important factor in cloth handling, plant engineers of the Kendall Mills, Charlotte, N. C. equipped a cloth handling machine with six MICRO switches at strategic points.

These switches operate to maintain the speed of the machine at the same number of pounds stretch per inch width throughout the handling process.

Plant engineers in all lines of industry are finding that the application of one or more of these precise, easily mounted switches is the most practical and economical way to make present equipment safer, more automatic and more productive.

Authorized MICRO distributors are located in over 100 key cities with complete stocks of switches best suited to individual plant requirements. Look for your nearest distributor under "Switches, Electric" in your classified phone book. For more detailed information, help is always available from your nearest MICRO branch office.

For live, practical ideas on switch applications, send for MICRO TIPS. We'll be glad to add your name to our mailing list.

MICRO
MAKERS OF PRECISION SWITCHES
FREEPORT, ILLINOIS

A DIVISION OF
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY

For more facts circle 642 on Reply Card

NEW WATER HEATING SYSTEM *Simplifies* WYNNEWOOD SCHOOL'S *Dining Room* OPERATION

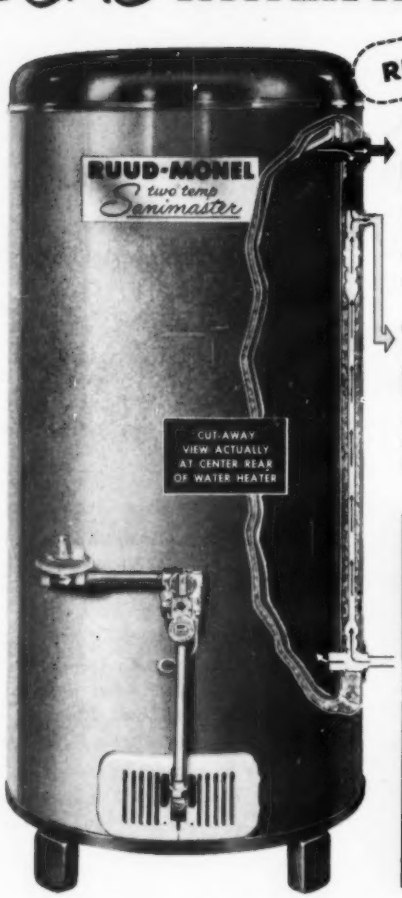
RUUD-MONEL two°temp Sanimaster

AUTOMATIC *GAS* WATER HEATER

Mrs. H. K. Wallace, dietitian at the Agnes Irwin Upper School, Wynnewood, Pennsylvania, is proud of her brand new kitchen. And rightly so. This modern kitchen has everything to make it really efficient.

And two of the things she's most pleased with are the twin Ruud-Monel Sanimasters. It takes plenty of sanitizing 180° hot water to wash all the dishes for the 700 meals served here every day. And there's a constant need, too, for regular 140° hot water for sinks and general use.

Yet Sanimaster delivers both these temperatures from the same tank at the same time! The Ruud-Monel Sanimaster is the *only* self-contained water heater on the market that will supply both regular-hot and extra-hot water from one tank at one time.



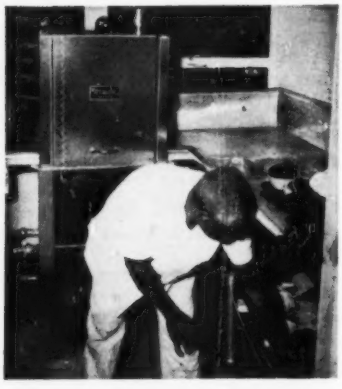
RUST PROOF

180° SANITIZING HOT WATER

is piped directly into the Sterling DS 50-G dishwasher. It provides positive bacteria destruction, perfect sanitation.

140° GENERAL USE HOT WATER

is available continuously at the 4 showers, 6 lavatories, plus all the kitchen sinks and chemistry lab sinks.



MONEL—NATURE'S WONDER METAL

SANIMASTER's tank is made of solid MONEL—the only metal that safely holds water at such high temperatures as 180°. And it will never rust! Ruud-Monel two°temp Sanimaster, with its exclusive long-life Monel tank, will give you sparkling clean hot water for years and years.

In addition to the Ruud-Monel two°temp Sanimaster, Ruud offers a complete line of water heaters for domestic, commercial and industrial applications.

For specifications, data and literature, write Dept. T12.

RUUD MANUFACTURING COMPANY

Pittsburgh 1, Pa. • *General Offices* • Toronto 14, Ontario

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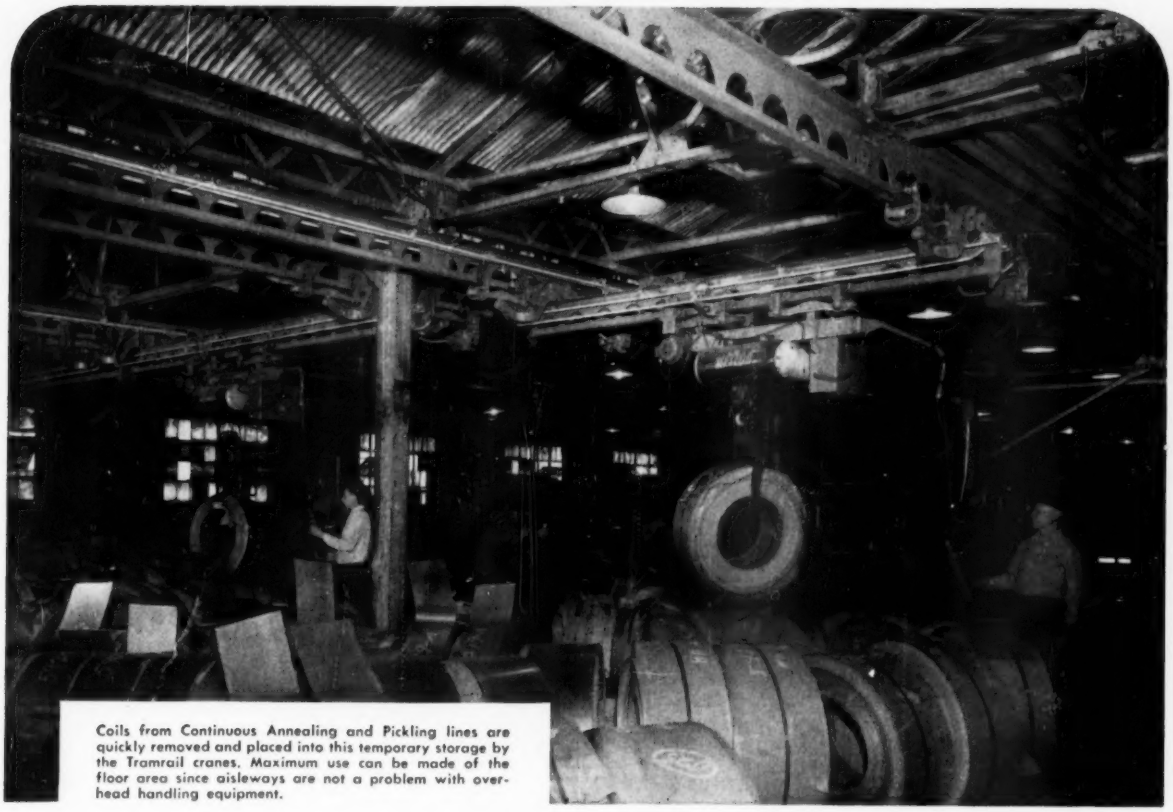
Tramrail Cranes BOOST Strip Production

Speed Handling—Cut "Down Time"—Aid Safety



Coils from Continuous Annealing and Pickling lines are quickly removed and placed into this temporary storage by the Tramrail cranes. Maximum use can be made of the floor area since aisleways are not a problem with overhead handling equipment.

As a leading producer of high quality alloy strip steels, mostly of light gauge, the Superior Steel Corp., Carnegie, Pa. has secured definite production advantages and greatly improved overall plant efficiency through abundant use of Cleveland Tramrail cranes.

As the work is primarily that of rolling, annealing, pickling and handling, to obtain maximum production from their equipment, it is necessary to keep it in operation as many minutes out of the day as possible. This means that there be no delays in handling the coils of strip to and from the mills. It also means that the mill rolls must be changed in the least possible time. The Tramrail cranes have proven of great success in fulfilling these requirements and reducing "down time" to a minimum.

They have also proven to be a great aid to the workers' welfare. Being fully motorized, they have practically eliminated all manual lifting and moving. As a result, worker fatigue has been reduced and safety improved.

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CLEVELAND TRAMRAIL DIVISION
THE CLEVELAND CRANE & ENGINEERING CO.
7583 EAST 284TH ST. WICKLIFFE, OHIO

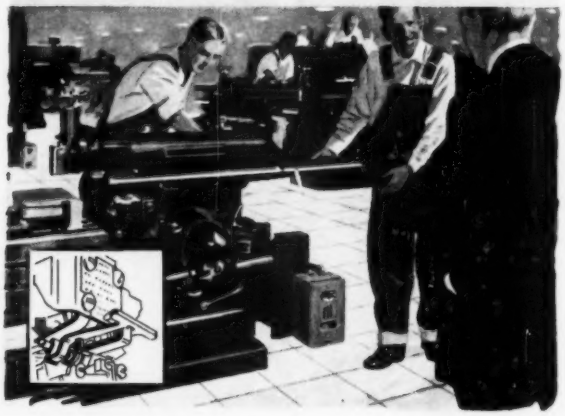
CLEVELAND TRAMRAIL
OVERHEAD MATERIALS HANDLING EQUIPMENT

For more facts circle 644 on Reply Card

THE THREE CUTLER-HAMMER STARS
★ ★ ★
STAND FOR THREE NEW STANDARDS

Rolling bearing action...

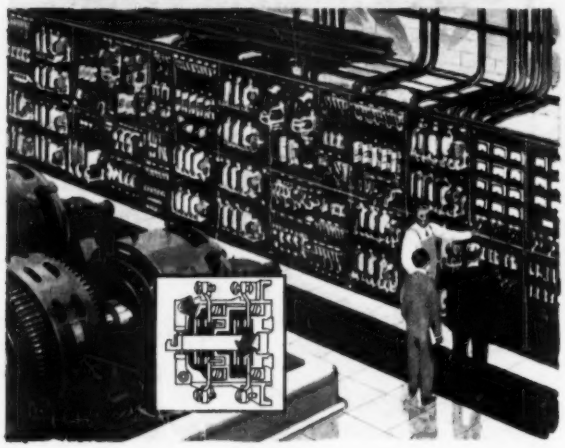
The proper performance and useful life of *all* modern machines demand anti-friction bearings. Motor control is no exception; it too must have good bearings to avoid wear and trouble.



☆ *installs easier*
☆ *works better*
☆ *lasts longer*

Dust-safe vertical contacts...

Experienced engineers *know* vertical contacts work better and last longer because they stay clean, shed dust, do not collect it. Pressure arc quenching is important new C-H feature.



Less bounce by the ounce...

Research showed contact bounce caused arcing, that reduced weight in moving contact members cut bounce and arcing. So new light-weight parts now remarkably lengthen contact life.

Cutler-Hammer Motor Control has always been respected for its long life. It has frequently been chosen for industry's "killer" jobs by comparative test. Many users say, "I have never seen a Cutler-Hammer starter wear out!" Yet the new Cutler-Hammer ☆☆☆ Motor Control has *three times* the life of the good equipment it replaces! Nearly unbelievable, but it IS true. Now motor control you can install and forget! Try it. Prove it. Your nearby Cutler-Hammer Authorized Distributor is ready to serve you. Order from him today. CUTLER-HAMMER, Inc., 1447 St. Paul Ave., Milwaukee 1, Wisconsin.

CUTLER-HAMMER ★ ★ ★ MOTOR CONTROL

For more facts circle 645 on Reply Card

TABLES ON THE THERMODYNAMIC PROPERTIES OF MOIST AIR

BY

BYRON A. ENGELBACH

REPRODUCED IN COOPERATION WITH

PLANT ENGINEERING

UNIVERSITY MICROFILMS
ANN ARBOR, MICHIGAN. 1953

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THERMODYNAMIC PROPERTIES OF MOIST AIR (STANDARD ATMOSPHERIC PRESSURE, 29.921 in Hg.)

FAHR. TEMP.	PRESSURE AT SATURATION			HUMIDITY RATIO				VOLUME			ENTHALPY			ENTROPY			CONDENSED WATER		FAHR. TEMP.
	inches Hg.	mm. Hg.	lb./sq. in.	Per Pound of Air: pounds	Per Pound of Air: grains	Per Cu. Ft. of Air: pounds	Per Cu. Ft. of Air: grains	Cubic Feet per Pound: Dry Air	Cubic Feet per Pound: Moisture	Cubic Feet per Pound: Saturated	Btu's per Cubic Foot of Dry Air: Dry Air	Btu's per Cubic Foot of Dry Air: Moisture	Btu's per Cubic Foot of Dry Air: Saturated	Btu per °F per lb. of Dry Air: Dry Air	Btu per °F per lb. of Dry Air: Moisture	Btu per °F per lb. of Dry Air: Saturated	Enthalpy Btu./lb.	Entropy Btu./(lb)(°F)	
t (F)	P_{s1}	P_{s2}	P_{s3}	W_{s1}	W_{s2}	W_{s3}	W_{s4}	V_a	V_{as}	V_s	h_a	h_{as}	h_s	s_a	s_{as}	s_s	h_w	s_w	t (F)
Sol. #1	Sol. #2	Sol. #3	Sol. #4	Sol. #5	Sol. #6	Sol. #7	Sol. #8	Sol. #9	Sol. #10	Sol. #11	Sol. #12	Sol. #13	Sol. #14	Sol. #15	Sol. #16	Sol. #17	Sol. #18	Sol. #19	Sol. #20
0.0	0.037645	0.9558	0.01849	0.0007872	5.5104	0.0000 6745	0.47215	11.578	0.015	11.593	0.000	0.835	0.835	0.00000	0.00192	0.00192	-158.930	-.3244	0.0
0.1	.0378471	.9622	.018589	.000 79143	5.54001	.000067824	.474908	11.5806	.015	11.5956	.024	.8395	.8635	.000052	.00193	.001982	-158.883	-.3243	0.1
0.2	.0380492	.9673	.018688	.000 79566	5.56962	.000068238	.477666	11.5832	.015	11.5982	.048	.8440	.8920	.000104	.00194	.002044	-158.836	-.3242	0.2
0.3	.0382513	.9723	.018787	.000 79989	5.59923	.000068632	.480424	11.5858	.015	11.6008	.072	.8485	.9205	.000156	.00195	.002106	-158.789	-.3241	0.3
0.4	.0384534	.9773	.018886	.000 80412	5.62884	.000069026	.483182	11.5884	.015	11.6034	.096	.8530	.9490	.000208	.00196	.002168	-158.742	-.3240	0.4
0.5	0.0386555	0.9824	0.018985	0.000 80835	5.65845	0.000069420	0.485940	11.5910	0.015	11.6060	0.120	0.8575	0.9775	0.000260	0.00197	0.002230	-158.695	-.3239	0.5
0.6	.0388576	.9874	.019084	.000 81258	5.68806	.000069814	.488698	11.5936	.015	11.6086	.144	.8620	1.0060	.000312	.00198	.002292	-158.648	-.3238	0.6
0.7	.0390597	.9924	.019183	.000 81681	5.71767	.000070208	.491456	11.5962	.015	11.6112	.168	.8665	1.0345	.000364	.00199	.002354	-158.601	-.3237	0.7
0.8	.0392618	.9974	.019282	.000 82104	5.74728	.000070602	.494214	11.5988	.015	11.6138	.192	.8710	1.0630	.000416	.00200	.002416	-158.554	-.3236	0.8
0.9	.0394639	1.0025	.019381	.000 82527	5.77689	.000070996	.496972	11.6014	.015	11.6164	.216	.8755	1.0915	.000468	.00201	.002478	-158.507	-.3235	0.9
1.0	0.039666	1.0075	0.01948	0.000 8295	5.8065	0.0000 7139	0.49973	11.604	0.015	11.619	0.240	0.880	1.120	0.000520	0.00202	0.00254	-158.460	-.3234	1.0
1.1	.0398779	1.0129	.019584	.000 83394	5.83758	.0000 71756	.502289	11.6065	.0151	11.6216	.264	.8848	1.1488	.000572	.00203	.002602	-158.413	-.32329	1.1
1.2	.0400898	1.0183	.019688	.000 83838	5.86866	.0000 72122	.504848	11.6090	.0152	11.6242	.288	.8896	1.1776	.000624	.00204	.002664	-158.366	-.32318	1.2
1.3	.0403017	1.0236	.019792	.000 84282	5.89974	.0000 72488	.507407	11.6115	.0153	11.6268	.312	.8944	1.2064	.000676	.00205	.002726	-158.319	-.32307	1.3
1.4	.0405136	1.0290	.019896	.000 84726	5.93082	.0000 72854	.509966	11.6140	.0154	11.6294	.336	.8992	1.2352	.000728	.00206	.002788	-158.272	-.32296	1.4
1.5	0.0407255	1.0344	0.020000	0.000 8517	5.96190	0.0000 73220	0.512525	11.6165	0.0155	11.6320	0.360	0.9040	1.2640	0.000780	0.00207	0.002850	-158.225	-.32285	1.5
1.6	.0409374	1.0398	.020104	.000 85614	5.99298	.0000 73586	.515084	11.6190	.0156	11.6346	.384	.9088	1.2928	.000832	.00208	.002912	-158.178	-.32274	1.6
1.7	.0411493	1.0452	.020208	.000 86056	6.02406	.0000 73952	.517643	11.6215	.0157	11.6372	.408	.9136	1.3216	.000884	.00209	.002974	-158.131	-.32263	1.7
1.8	.0413612	1.0505	.020312	.000 86502	6.05514	.0000 74318	.520202	11.6240	.0158	11.6398	.432	.9184	1.3504	.000936	.00210	.003036	-158.084	-.32252	1.8
1.9	.0415731	1.0559	.020416	.000 86946	6.08622	.0000 74684	.522761	11.6265	.0159	11.6424	.456	.9232	1.3792	.000988	.00211	.003098	-158.037	-.32241	1.9
2.0	0.041785	1.0613	0.020952	0.000 8739	6.1173	0.0000 7505	0.52552	11.629	0.016	11.645	0.480	0.928	1.408	0.00104	0.00212	0.00316	-157.990	-.3223	2.0
2.1	.0420072	1.0670	.020629	.000 87855	6.14985	.0000 75431	.52799	11.6315	.0161	11.6476	.5041	.9329	1.4570	.001092	.002131	.003223	-157.943	-.3222	2.1
2.2	.0422294	1.0726	.020738	.000 88320	6.18240	.0000 75812	.53066	11.6340	.0162	11.6502	.5282	.9378	1.4660	.001144	.002142	.003286	-157.896	-.3221	2.2
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2.4	.0426738	1.0839	.020956	.000 89250	6.24750	.0000 76574	.53600	11.6390	.0164	11.6554	.5764	.9476	1.5240	.001248	.002164	.003412	-157.802	-.3219	2.4
2.5	0.0428960	1.0896	0.021065	0.000 89715	6.28005	0.0000 76955	0.53867	11.6415	0.0165	11.6580	0.6005	0.9525	1.5530	0.001300	0.002175	0.003475	-157.755	-.3218	2.5
2.6	.0431182	1.0952	.021174	.000 90180	6.31260	.0000 77336	.54134	11.6440	.0166	11.6606	.6246	.9574	1.5820	.001352	.002186	.003538	-157.708	-.3217	2.6
2.7	.0433404	1.1009	.021283	.000 90645	6.34515	.0000 77717	.54401	11.6465	.0167	11.6632	.6487	.9623	1.6110	.001404	.002197	.003601	-157.661	-.3216	2.7
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2.9	.0437848	1.1122	.021501	.000 91575	6.41025	.0000 78479	.54935	11.6515	.0169	11.6684	.6969	.9721	1.6690	.001508	.002219	.003727	-157.567	-.3214	2.9
3.0	0.044007	1.1178	0.02161	0.0009204	6.4428	0.0000 7886	0.55202	11.654	0.017	11.671	0.721	0.977	1.698	0.00156	0.00223	0.00379	-157.520	-.3213	3.0
3.1	.044240	1.1237	.021725	.000 92528	6.47696	.0000 7926	.55482	11.6565	.0171	11.6736	.745	.9823	1.7273	.001612	.002241	.003853	-157.472	-.3212	3.1
3.2	.044473	1.1296	.021840	.000 93016	6.51112	.0000 7966	.55762	11.6590	.0172	11.6762	.769	.9876	1.7586	.001664	.002252	.003916	-157.424	-.3211	3.2
3.3	.044706	1.1356	.021955	.000 93504	6.54528	.0000 8006	.56042	11.6615	.0173	11.6788	.793	.9929	1.7859	.001716	.002263	.003979	-157.376	-.3210	3.3
3.4	.044939	1.1415	.022070	.000 93992	6.57942	.0000 8046	.56322	11.6640	.0174	11.6814	.817	.9982	1.8152	.001768	.002274	.004042	-157.328	-.3209	3.4
3.5	0.045172	1.1474	0.022185	0.000 94480	6.61360	0.0000 8086	0.56602	11.6665	0.0175	11.6840	0.841	1.0035	1.8445	0.001820	0.002285	0.004105	-157.280	-.3208	3.5
3.6	.045405	1.1533	.022300	.000 94968	6.64776	.0000 8126	.56882	11.6690	.0176	11.6866	.865	1.0088	1.8738	.001872	.002296	.004168	-157.232	-.3207	3.6
3.7	.045638	1.1592	.022415	.000 95456	6.68192	.0000 8166	.57162	11.6715	.0177	11.6892	.889	1.0141	1.9031	.001924	.002307	.004231	-157.184	-.3206	3.7
3.8	.045871	1.1652	.022530	.000 95944	6.71608	.0000 8206	.57442	11.6740	.0178	11.6918	.913	1.0194	1.9324	.001976	.002318	.004294	-157.136	-.3205	3.8
3.9	.046104	1.1711	.022645	.000 96432	6.75024	.0000 8246	.57722	11.6765	.0179	11.6944	.937	1.0247	1.9617	.002028	.002329	.004357	-157.088	-.3204	3.9
4.0	0.046337	1.1770	0.02276	0.000 9692	6.7844	0.0000 8286	0.58002	11.679	0.018	11.697	0.961	1.030	1.991	0.00208	0.00234	0.00442	-157.040	-.3203	4.0
4.1	.0465812	1.1832	.02288	.000 97428	6.81996	.0000 83274	.582918	11.6816	.0181	11.6997	.985	1.0355	2.0205	.002152	.002352	.004484	-156.993	-.3202	4.1
4.2	.0468254	1.1894	.02300	.000 97936	6.85552	.0000 83688	.585816	11.6842	.0182	11.7024	1.008	1.0410	2.0500	.002184	.002364	.004548	-156.946	-.3201	4.2
4.3	.0470696	1.1956	.02312	.000 98444	6.89108	.0000 84102	.588714	11.6868	.0183	11.7051	1.033	1.0465	2.0795	.002236	.002376	.004612	-156.899	-.3200	4.3
4.4	.0473138	1.2018	.02324	.000 98952	6.92664	.0000 84516	.591612	11.6894	.0184	11.7078	1.057	1.0520	2.1090	.002288	.002388	.004676	-156.852	-.3199	4.4

4.5	0.0475580	1.2080	0.023360	0.00099460	6.96220	0.00084930	0.594510	11.6920	0.0185	11.7105	1.081	1.0575	2.1385	0.002340	0.002400	0.004740	-156.805	-.3198	4.5
4.6	.0478022	1.2142	.023480	.00099968	6.99776	.00085344	.597408	11.6946	.0186	11.7132	1.105	1.0630	2.1680	.002392	.002412	.004804	-156.758	-.3197	4.6
4.7	.0480464	1.2204	.023600	.00100476	7.03332	.00085758	.600306	11.6972	.0187	11.7159	1.129	1.0685	2.1975	.002444	.002424	.004868	-156.711	-.3196	4.7
4.8	.0482906	1.2266	.023720	.00100984	7.06888	.00086172	.603204	11.6998	.0188	11.7186	1.153	1.0740	2.2270	.002496	.002436	.004932	-156.664	-.3195	4.8
4.9	.0485348	1.2328	.023840	.00101492	7.10444	.00086586	.606102	11.7024	.0189	11.7213	1.177	1.0795	2.2565	.002548	.002448	.004996	-156.617	-.3194	4.9
5.0	0.048779	1.2390	0.02396	0.001020	7.1400	0.00008700	0.6090	11.705	0.0190	11.724	1.201	1.085	2.286	0.002600	0.002460	0.005060	-156.57	-.3193	5.0
5.1	.0490350	1.2455	.024085	.00102544	7.17780	.00008744	.61208	11.7075	.0191	11.7266	1.225	1.0907	2.3157	.002652	.002472	.005124	-156.522	-.31919	5.1
5.2	.0492910	1.2520	.024210	.00103068	7.21560	.00008788	.61516	11.7100	.0192	11.7292	1.249	1.0964	2.3454	.002704	.002484	.005188	-156.474	-.31908	5.2
5.3	.0495470	1.2585	.024335	.00103620	7.25340	.00008832	.61824	11.7125	.0193	11.7318	1.273	1.1021	2.3751	.002756	.002496	.005252	-156.426	-.31897	5.3
5.4	.0498030	1.2650	.02446	.00104176	7.29120	.00008876	.62132	11.7150	.0194	11.7344	1.297	1.1078	2.4048	.002808	.002508	.005316	-156.378	-.31886	5.4
5.5	0.0500590	1.2715	0.024585	0.0010470	7.32900	0.0000 8920	0.62440	11.7175	0.0195	11.7370	1.321	1.1135	2.4345	0.002860	0.002520	0.005380	-156.330	-.31875	5.5
5.6	.0503150	1.2780	.024710	.00105240	7.36680	.0000 8964	.62748	11.7200	.0196	11.7396	1.345	1.1192	2.4642	.002912	.002532	.005444	-156.282	-.31864	5.6
5.7	.0505710	1.2845	.024835	.00105780	7.40460	.0000 9008	.63056	11.7225	.0197	11.7422	1.369	1.1249	2.4939	.002964	.002544	.005508	-156.234	-.31853	5.7
5.8	.0508270	1.2910	.024960	.00106324	7.44240	.0000 9052	.63364	11.7250	.0198	11.7448	1.393	1.1306	2.5236	.003016	.002556	.005572	-156.186	-.31842	5.8
5.9	.0510830	1.2975	.025085	.00106868	7.48020	.0000 9096	.63672	11.7275	.0199	11.7474	1.417	1.1363	2.5533	.003068	.002568	.005636	-156.138	-.31831	5.9
6.0	0.051339	1.3065	0.02521	0.001074	7.5180	0.0000 9140	0.6398	11.730	0.0200	11.750	1.441	1.142	2.583	0.003120	0.002580	0.005700	-156.090	-.3182	6.0
6.1	.0516078	1.31307	.025342	.00107960	7.5572	.00091855	.64299	11.7326	.0201	11.7527	1.4650	1.148	2.6130	.003172	.002593	.005765	-156.042	-.3181	6.1
6.2	.0518756	1.31964	.025474	.00108520	7.5964	.00092310	.64617	11.7352	.0202	11.7554	1.4890	1.154	2.6430	.003224	.002606	.005830	-155.994	-.3180	6.2
6.3	.0521439	1.32621	.025606	.00109080	7.6356	.00092765	.64936	11.7378	.0203	11.7581	1.5130	1.160	2.6730	.003276	.002619	.005895	-155.946	-.3179	6.3
6.4	.0524122	1.33278	.025738	.00109640	7.6748	.00093220	.65254	11.7404	.0204	11.7608	1.5370	1.166	2.7030	.003328	.002632	.005960	-155.898	-.3178	6.4
6.5	0.0526805	1.33935	0.025870	0.0011020	7.7140	0.00093675	0.65573	11.7430	0.0205	11.7635	1.5610	1.172	2.7330	0.003380	0.002645	0.006025	-155.850	-.3177	6.5
6.6	.0529488	1.34592	.026002	.00110760	7.7532	.00094130	.65891	11.7456	.0206	11.7662	1.585	1.178	2.7630	.003432	.002658	.006090	-155.802	-.3176	6.6
6.7	.0532171	1.35249	.026134	.00111320	7.7924	.00094585	.66219	11.7482	.0207	11.7689	1.609	1.184	2.7930	.003484	.002671	.006155	-155.754	-.3175	6.7
6.8	.0534854	1.35906	.026266	.00111880	7.7836	.00095040	.66528	11.7508	.0208	11.7716	1.633	1.190	2.8230	.003536	.002684	.006220	-155.706	-.3174	6.8
6.9	.0537537	1.36563	.026398	.00112440	7.8708	.00095495	.66847	11.7534	.0209	11.7743	1.657	1.196	2.8530	.003588	.002697	.006285	-155.658	-.3173	6.9
7.0	0.054022	1.3722	0.026530	0.00 1130	7.9100	0.00009595	0.67165	11.756	0.0210	11.777	1.681	1.202	2.885	0.00364	0.002471	0.00635	-155.610	-.3172	7.0
7.1	.0543030	1.37933	.026668	.00 11359	7.9513	.00096425	.67498	11.7585	.0211	11.7796	1.7051	1.2084	2.9135	.003691	.002724	.006415	-155.562	-.3171	7.1
7.2	.0545840	1.38646	.026806	.00 11418	7.9926	.00096900	.67830	11.7610	.0212	11.7822	1.7292	1.2148	2.9440	.003742	.002738	.006480	-155.514	-.3170	7.2
7.3	.0548650	1.39359	.026944	.00 11477	8.0339	.00097375	.68163	11.7635	.0213	11.7848	1.7533	1.2212	2.9745	.003793	.002752	.006545	-155.466	-.3169	7.3
7.4	.0551460	1.40072	.027082	.00 11536	8.0752	.00097850	.68495	11.7660	.0214	11.7874	1.7774	1.2276	3.0050	.003844	.002766	.006610	-155.418	-.3168	7.4
7.5	0.0554270	1.40785	0.027220	0.00 11595	8.6165	0.00098325	0.68828	11.7685	0.0215	11.7900	1.8015	1.2340	3.0355	0.003895	0.002780	0.006675	-155.370	-.3167	7.5
7.6	.0557080	1.41498	.027358	.00 11654	8.1578	.00098800	.69160	11.7710	.0216	11.7926	1.8256	1.2404	3.0660	.003946	.002794	.006740	-155.320	-.3166	7.6
7.7	.0559890	1.42211	.027496	.00 11713	8.1991	.00099275	.69493	11.7735	.0217	11.7952	1.8497	1.2468	3.0965	.003997	.002808	.006805	-155.274	-.3165	7.7
7.8	.0562700	1.42924	.027634	.00 11773	8.2404	.00099750	.69825	11.7760	.0218	11.7978	1.8738	1.2532	3.1270	.004048	.002822	.006870	-155.226	-.3164	7.8
7.9	.0565510	1.43637	.027772	.00 11831	8.2817	.00100225	.70158	11.7785	.0219	11.8004	1.8979	1.2596	3.1575	.004099	.002836	.006935	-155.178	-.3163	7.9
8.0	0.056832	1.4435	0.027910	0.00 1189	8.323	0.0001007	0.7049	11.781	0.0220	11.803	1.922	1.266	3.188	0.00415	0.00285	0.00700	-155.130	-.3162	8.0
8.1	.0571264	1.45098	.028055	.00 11952	8.3664	.0001012	.7084	11.7835	.0222	11.8057	1.946	1.2726	3.2186	.004202	.002864	.007066	-155.084	-.3161	8.1
8.2	.0574208	1.45846	.028200	.00 12014	8.4098	.0001017	.7119	11.7860	.0224	11.8084	1.970	1.2792	3.2492	.004254	.002878	.007132	-155.038	-.3160	8.2
8.3	.0577152	1.46594	.028345	.00 12076	8.4532	.0001022	.7154	11.7885	.0226	11.8111	1.994	1.2858	3.2798	.004306	.002892	.007198	-154.992	-.3159	8.3
8.4	.0580096	1.47342	.028490	.00 12138	8.4966	.0001027	.7189	11.7910	.0228	11.8138	2.018	1.2924	3.3104	.004358	.002906	.007264	-154.946	-.3158	8.4
8.5	0.0583040	1.48090	0.028635	0.0012200	8.5400	0.0001032	0.7224	11.7935	0.0230	11.8165	2.042	1.2990	3.3410	0.004410	0.002920	0.007330	-154.900	-.3157	8.5
8.6	.0585984	1.48838	.028780	.00122620	8.5834	.0001037	.7259	11.7960	.0232	11.8192	2.066	1.3056	3.3716	.004462	.002934	.007396	-154.854	-.3156	8.6
8.7	.0588928	1.49586	.028925	.00123240	8.6268	.0001042	.7294	11.7985	.0234	11.8219	2.090	1.3122	3.4022	.004514	.002948	.007462	-154.808	-.3155	8.7
8.8	.0591872	1.50334	.029075	.00123860	8.6702	.0001047	.7329	11.8010	.0236	11.8246	2.114	1.3188	3.4328	.004566	.002962	.007528	-154.762	-.3154	8.8
8.9	.0594816	1.51082	.029215	.00124480	8.7136	.0001052	.7364	11.8035	.0238	11.8273	2.138	1.3254	3.4634	.004618	.002976	.007594	-154.716	-.3153	8.9

9.0	0.059776	1.5183	0.02936	0.001251	8.757	0.0001057	0.7399	11.806	0.024	11.830	2.162	1.338	3.434	0.00467	0.00299	0.00766	-154.67	-.3152	9.0
9.1	.0600842	1.52622	.029511	.0012574	8.8018	.00010622	.74754	11.8085	.0241	11.8326	2.186	1.3389	3.5249	.004721	.003005	.007726	-154.62	-.31509	9.1
9.2	.0603924	1.53414	.029662	.0012638	8.8466	.00010674	.74718	11.8110	.0242	11.8352	2.210	1.3458	3.5558	.004772	.003020	.007792	-154.57	-.31498	9.2
9.3	.0607006	1.54206	.029813	.0012702	8.8914	.00010726	.75082	11.8135	.0243	11.8378	2.234	1.3527	3.5867	.004823	.003035	.007858	-154.52	-.31487	9.3
9.4	.0610088	1.54998	.029964	.0012766	8.9362	.00010778	.75446	11.8160	.0244	11.8404	2.258	1.3596	3.6176	.004874	.003050	.007924	-154.47	-.31476	9.4
9.5	0.0613170	1.55790	0.030115	0.0012830	8.9810	0.00010830	0.75810	11.8185	0.0245	11.8430	2.282	1.3665	3.6485	0.004925	0.003065	0.007990	-154.42	-.31465	9.5
9.6	.0616252	1.56582	.030266	.0012894	9.0258	.00010882	.76174	11.8210	.0246	11.8456	2.306	1.3734	3.6794	.004976	.003080	.008056	-154.37	-.31454	9.6
9.7	.0619334	1.57374	.030417	.0012958	9.0706	.00010934	.76538	11.8235	.0247	11.8482	2.330	1.3803	3.7103	.005027	.003095	.008122	-154.32	-.31443	9.7
9.8	.0622416	1.58166	.030568	.0013022	9.1154	.00010986	.76902	11.8260	.0248	11.8508	2.354	1.3872	3.7412	.005078	.003110	.008188	-154.27	-.31432	9.8
9.9	.0625498	1.58958	.030719	.0013086	9.1602	.00011038	.77266	11.8285	.0249	11.8534	2.378	1.3941	3.7721	.005129	.003125	.008254	-154.22	-.31421	9.9
10.0	0.062858	1.5975	0.03087	0.001315	9.205	0.0001109	0.7763	11.831	0.025	11.856	2.407	1.401	3.803	0.00518	0.00314	0.00832	-154.17	-.3141	10.0
10.1	.0631807	1.60561	.031029	.0013218	9.2526	.00011145	.78015	11.8336	.0251	11.8587	2.426	1.4083	3.8343	.005231	.003156	.008387	-154.122	-.3140	10.1
10.2	.0635034	1.61372	.031188	.0013286	9.3002	.00011200	.78400	11.8362	.0252	11.8614	2.450	1.4156	3.8656	.005282	.003177	.008454	-154.074	-.3139	10.2
10.3	.0638261	1.62183	.031347	.0013354	9.3478	.00011255	.78785	11.8388	.0253	11.8641	2.474	1.4229	3.8969	.005333	.003188	.008521	-154.026	-.3138	10.3
10.4	.0641488	1.62994	.031506	.0013422	9.3954	.00011310	.79170	11.8414	.0254	11.8668	2.498	1.4302	3.9282	.005384	.003204	.008588	-153.978	-.3137	10.4
10.5	0.0644715	1.63805	0.031665	0.0013490	9.4430	0.00011365	0.79555	11.8440	0.0255	11.8695	2.522	1.4375	3.9595	0.005435	0.003220	0.008655	-153.930	-.3136	10.5
10.6	.0647942	1.64616	.031824	.0013558	9.4906	.00011420	.79940	11.8466	.0256	11.8722	2.546	1.4448	3.9908	.005486	.003236	.008722	-153.882	-.3135	10.6
10.7	.0651169	1.65427	.031983	.0013626	9.5382	.00011475	.80325	11.8492	.0257	11.8749	2.570	1.4521	4.0221	.005537	.003252	.008789	-153.834	-.3134	10.7
10.8	.0654396	1.66238	.032142	.0013694	9.5858	.00011530	.80710	11.8518	.0258	11.8776	2.594	1.4594	4.0534	.005588	.003268	.008856	-153.786	-.3133	10.8
10.9	.0657623	1.67049	.032301	.0013762	9.6334	.00011585	.81095	11.8544	.0259	11.8803	2.618	1.4667	4.0847	.005639	.003284	.008923	-153.738	-.3132	10.9
11.0	0.066085	1.6786	0.03246	0.001383	9.681	0.0001164	0.8148	11.857	0.026	11.883	2.642	1.474	4.116	0.00569	0.00330	0.00899	-153.69	-.3131	11.0
11.1	.0664227	1.68717	.032626	.0013901	9.7307	.00011697	.81879	11.8595	.0262	11.8857	2.666	1.4816	4.1476	.005741	.003316	.009057	-153.642	-.3130	11.1
11.2	.0667604	1.69574	.032792	.0013972	9.7804	.00011754	.82278	11.8620	.0264	11.8884	2.690	1.4892	4.1792	.005792	.003332	.009124	-153.594	-.3129	11.2
11.3	.0670981	1.70431	.032958	.0014043	9.8301	.00011811	.82677	11.8645	.0266	11.8911	2.714	1.4968	4.2108	.005843	.003348	.009191	-153.546	-.3128	11.3
11.4	.0674358	1.71288	.033124	.0014114	9.8798	.00011868	.83076	11.8670	.0268	11.8938	2.738	1.5044	4.2424	.005894	.003364	.009258	-153.498	-.3127	11.4
11.5	0.0677735	1.72145	0.033290	0.0014185	9.9295	0.00011925	0.83475	11.8695	0.0270	11.8965	2.762	1.5120	4.2740	0.005945	0.003380	0.009325	-153.450	-.3126	11.5
11.6	.0681112	1.73002	.033456	.0014256	9.9792	.00011987	.83874	11.8720	.0272	11.8992	2.786	1.5196	4.3056	.005996	.003396	.009392	-153.402	-.3125	11.6
11.7	.0684489	1.73859	.033622	.0014327	10.0289	.00012039	.84273	11.8745	.0274	11.9019	2.810	1.5272	4.3372	.006047	.003412	.009459	-153.354	-.3124	11.7
11.8	.0687866	1.74716	.033788	.0014398	10.0786	.00012096	.84672	11.8770	.0276	11.9046	2.834	1.5348	4.3688	.006098	.003428	.009526	-153.306	-.3123	11.8
11.9	.0691245	1.75573	.033954	.0014469	10.1283	.00012153	.85071	11.8795	.0278	11.9073	2.858	1.5424	4.4004	.006149	.003444	.009593	-153.258	-.3122	11.9
12.0	0.069462	1.7643	0.03412	0.001454	10.178	0.0001221	0.8547	11.882	0.028	11.910	2.882	1.550	4.432	0.00620	0.00346	0.00966	-153.21	-.3121	12.0
12.1	.0698155	1.77388	.034793	.0014614	10.2298	.00012269	.85883	11.8845	.0281	11.9126	2.9061	1.5580	4.4641	.006251	.003477	.009728	-153.162	-.3120	12.1
12.2	.0701690	1.78226	.034466	.0014688	10.2816	.00012328	.86296	11.8870	.0282	11.9152	2.9302	1.5660	4.4967	.006302	.003494	.009796	-153.114	-.3119	12.2
12.3	.0705225	1.79124	.034639	.0014762	10.3334	.00012387	.86709	11.8895	.0283	11.9178	2.9543	1.5740	4.5283	.006353	.003511	.009864	-153.066	-.3118	12.3
12.4	.0708760	1.80022	.034812	.0014836	10.3852	.00012446	.87122	11.8920	.0284	11.9204	2.9784	1.5820	4.5604	.006404	.003528	.009932	-153.018	-.3117	12.4
12.5	0.0712295	1.80920	0.034985	0.0014910	10.4370	0.00012505	0.87535	11.8945	0.0285	11.9230	3.0025	1.5900	4.5925	0.006455	0.003455	0.010000	-152.97	-.3116	12.5
12.6	.0715830	1.81818	.035158	.0014984	10.4888	.00012564	.87948	11.8970	.0286	11.9256	3.0266	1.5980	4.6246	.006506	.003562	.010068	-152.922	-.3115	12.6
12.7	.0719365	1.82716	.035331	.0015058	10.5406	.00012623	.88361	11.8995	.0287	11.9282	3.0507	1.6060	4.6567	.006557	.003579	.010136	-152.874	-.3114	12.7
12.8	.0722900	1.83614	.035504	.0015132	10.5924	.00012682	.88774	11.9020	.0288	11.9308	3.0748	1.6140	4.6888	.006608	.003596	.010204	-152.826	-.3113	12.8
12.9	.0726435	1.84512	.035677	.0015206	10.6442	.00012741	.89187	11.9045	.0289	11.9334	3.0989	1.6226	4.7209	.006659	.003613	.010272	-152.778	-.3112	12.9
13.0	0.072997	1.8541	0.03585	0.001528	10.696	0.0001280	0.8960	11.907	0.029	11.936	3.123	1.630	4.753	0.00671	0.00363	0.01034	-152.73	-.3111	13.0
13.1	.0733669	1.8635	.036032	.0015358	10.7506	.00012862	.90034	11.9096	.0291	11.9387	3.147	1.6383	4.7853	.00676	.003647	.010407	-152.681	-.31099	13.1
13.2	.0737368	1.8729	.036214	.0015436	10.8052	.00012924	.90468	11.9122	.0292	11.9414	3.171	1.6466	4.8176	.00681	.003664	.010474	-152.632	-.31088	13.2
13.3	.0741067	1.8823	.036396	.0015514	10.8598	.00012986	.90902	11.9148	.0293	11.9441	3.195	1.6549	4.8499	.00686	.003681	.010541	-152.583	-.31077	13.3
13.4	.0744766	1.8917	.036578	.0015592	10.9144	.00013048	.91336	11.9174	.0294	11.9468	3.219	1.6632	4.8822	.00691	.003698	.010608	-152.534	-.31066	13.4

13.5	0.0746465	1.9011	0.036760	0.0015670	10.9690	0.00013110	0.91770	11.9200	0.0295	11.9495	3.243	1.6715	4.9145	0.00696	0.003715	0.010675	-152.485	-.31055	13.5
13.6	.0752164	1.9105	.036942	.0015748	11.0236	.00013172	.92204	11.9226	.0296	11.9522	3.247	1.6798	4.9468	.00701	.003732	.010742	-152.436	-.31044	13.6
13.7	.0755863	1.9199	.037124	.0015826	11.0782	.00013234	.92638	11.9252	.0297	11.9549	3.291	1.6881	4.9791	.00706	.003749	.010809	-152.387	-.31033	13.7
13.8	.0759562	1.9293	.037306	.0015904	11.1328	.00013296	.93072	11.9278	.0298	11.9576	3.315	1.6964	5.0114	.00711	.003766	.010876	-152.338	-.31022	13.8
13.9	.0763261	1.9387	.037488	.0015982	11.1874	.00013358	.93506	11.9304	.0299	11.9603	3.339	1.7047	5.0437	.00716	.003783	.010943	-152.289	-.31011	13.9
14.0	0.076696	1.9481	0.03767	0.001606	11.242	0.0001342	0.9394	11.9330	0.030	11.963	3.363	1.713	5.076	0.00721	0.00380	0.01101	-152.240	-.3100	14.0
14.1	.0770829	1.9580?	.037860	.0016141	11.2987	.00013485	.94495	11.9355	.0302	11.9657	3.387	1.7217	5.1087	.00726?	.003819	.01108	-152.192	-.3099	14.1
14.2	.0774698	1.96796	.03805	.0016222	11.3554	.00013550	.94850	11.9380	.0304	11.9684	3.411	1.7304	5.1414	.00731?	.003838	.01115	-152.144	-.3098	14.2
14.3	.0778567	1.97789	.03824	.0016303	11.4121	.00013615	.95305	11.9405	.0306	11.9711	3.435	1.7391	5.1741	.00736?	.003857	.01122	-152.096	-.3097	14.3
14.4	.0782436	1.98782	.03843	.0016384	11.4688	.00013680	.95760	11.9430	.0308	11.9738	3.459	1.7478	5.2068	.00741?	.003876	.01129	-152.048	-.3096	14.4
14.5	0.0786305	1.99775	0.03862	0.0016465	11.5255	0.00013745	0.96215	11.9455	0.0310	11.9765	3.483	1.7565	5.2395	0.00746?	0.003895	0.01136	-152.000	-.3095	14.5
14.6	.0790174	2.00768	.03881	.0016546	11.5822	.00013810	.96670	11.9480	.0312	11.9792	3.507	1.7652	5.2722	.00751?	.003914	.01143	-151.952	-.3094	14.6
14.7	.0794043	2.01761	.03900	.0016627	11.6389	.00013875	.97125	11.9505	.0314	11.9819	3.531	1.7739	5.3049	.00756?	.003933	.01150	-151.904	-.3093	14.7
14.8	.0797912	2.02754	.03919	.0016708	11.6956	.00013940	.97580	11.9530	.0316	11.9846	3.555	1.7826	5.3376	.00761?	.003952	.01157	-151.856	-.3092	14.8
14.9	.0801781	2.03747	.03938	.0016789	11.7523	.00014005	.98035	11.9555	.0318	11.9873	3.579	1.7913	5.3703	.00766?	.003971	.01164	-151.808	-.3091	14.9
15.0	0.080565	2.0474	0.03957	0.001687	11.809	0.0001407	0.9849	11.958	0.032	11.990	3.603	1.800	5.403	0.00772	0.00399	0.01171	-151.760	-.309	15.0
15.1	.0809697	2.05757	.039769	.0016955	11.8685	.00014137	.98959	11.9605	.0322	11.9927	3.627	1.8092	5.4362	.00777	.004009	.011779	-151.711	-.3089	15.1
15.2	.0813744	2.06774	.039968	.0017040	11.9280	.00014204	.99428	11.9630	.0324	11.9954	3.651	1.8184	5.4694	.00782	.004028	.011848	-151.662	-.3088	15.2
15.3	.0817791	2.07791	.040167	.0017125	11.9875	.00014271	.99897	11.9655	.0326	11.9981	3.675	1.8276	5.5026	.00787	.004047	.011917	-151.613	-.3087	15.3
15.4	.0821838	2.08808	.040366	.0017210	12.0470	.00014338	1.00366	11.9680	.0328	12.0008	3.699	1.8368	5.5358	.00792	.004066	.011986	-151.564	-.3086	15.4
15.5	0.0825885	2.09825	0.040565	0.0017295	12.1065	0.00014405	1.00835	11.9705	0.0330	12.0035	3.723	1.8460	5.5690	0.00797	0.004085	0.012055	-151.515	-.3085	15.5
15.6	.0829932	2.10842	.040764	.0017380	12.1660	.00014472	1.01304	11.9730	.0332	12.0062	3.747	1.8552	5.6022	.00802	.004104	.012124	-151.466	-.3084	15.6
15.7	.0833979	2.11859	.040963	.0017465	12.2255	.00014539	1.01773	11.9755	.0334	12.0089	3.771	1.8644	5.6354	.00807	.004123	.012193	-151.417	-.3083	15.7
15.8	.0838026	2.12876	.041162	.0017550	12.2850	.00014606	1.02242	11.9780	.0336	12.0116	3.795	1.8736	5.6686	.00812	.004142	.012262	-151.368	-.3082	15.8
15.9	.0842073	2.13893	.041361	.0017635	12.3445	.00014673	1.02711	11.9805	.0338	12.0143	3.819	1.8828	5.7018	.00817	.004161	.012331	-151.319	-.3081	15.9
16.0	0.084612	2.1491	0.04156	0.001772	12.404	0.0001474	1.0318	11.983	0.034	12.017	3.843	1.892	5.735	0.00822	0.00418	0.012400	-151.27	-.308	16.0
16.1	.0850351	2.15985	.041767	.0017809	12.4663	.00014811	1.03677	11.9856	.0341	12.0197	3.867	1.9016	5.7686	.00827?	.004220	.012471	-151.221	-.3079	16.1
16.2	.0854582	2.17060	.041974	.0017898	12.5286	.00014882	1.04174	11.9882	.0342	12.0224	3.891	1.9112	5.8022	.00832?	.004222	.012542	-151.172	-.3078	16.2
16.3	.0858813	2.18135	.042181	.0017987	12.5909	.00014953	1.04671	11.9908	.0343	12.0251	3.915	1.9208	5.8358	.00837?	.004224	.012613	-151.123	-.3077	16.3
16.4	.0863044	2.19210	.042388	.0018076	12.6532	.00015024	1.05168	11.9934	.0344	12.0278	3.939	1.9304	5.8694	.00842?	.004226	.012684	-151.074	-.3076	16.4
16.5	0.0867275	2.20285	0.042595	0.0018165	12.7155	0.00015095	1.05665	11.9960	0.0345	12.0305	3.963	1.9400	5.9030	0.00847?	0.00428	0.012755	-151.025	-.3075	16.5
16.6	.0871506	2.21360	.042802	.0018254	12.7778	.00015166	1.06162	11.9986	.0346	12.0332	3.987	1.9496	5.9366	.00852?	.004230	.012826	-150.976	-.3074	16.6
16.7	.0875737	2.22435	.043009	.0018343	12.8401	.00015237	1.06659	12.0012	.0347	12.0359	4.011	1.9592	5.9702	.00857?	.004232	.012897	-150.927	-.3073	16.7
16.8	.0879968	2.23510	.043216	.0018432	12.9024	.00015308	1.07156	12.0038	.0348	12.0386	4.035	1.9688	6.0038	.00862?	.004234	.012968	-150.878	-.3072	16.8
16.9	.0884199	2.24585	.043423	.0018521	12.9647	.00015379	1.07653	12.0064	.0349	12.0413	4.059	1.9784	6.0374	.00867?	.004236	.013039	-150.829	-.3071	16.9
17.0	0.088843	2.2566	0.04363	0.001861	13.027	0.0001545	1.0815	12.009	0.035	12.044	4.083	1.988	6.071	0.00873	0.00438	0.01311	-150.78	-.3070	17.0
17.1	.0892854	2.26784	.043848	.0018702	13.0914	.00015523	1.08661	12.0115	.0353	12.0468	4.1071	1.998	6.1051	.00878	.004401	.013181	-150.731	-.30689	17.1
17.2	.0897278	2.27908	.044066	.0018794	13.1558	.00015596	1.09172	12.0140	.0356	12.0496	4.1312	2.008	6.1392	.00883	.004422	.013252	-150.682	-.30678	17.2
17.3	.0901702	2.29032	.044284	.0018886	13.2202	.00015669	1.09683	12.0165	.0359	12.0524	4.1553	2.018	6.1733	.00888	.004443	.013323	-150.633	-.30667	17.3
17.4	.0906126	2.30156	.044502	.0018978	13.2846	.00015742	1.10194	12.0190	.0362	12.0552	4.1794	2.028	6.2074	.00893	.004464	.013394	-150.584	-.30656	17.4
17.5	0.0910550	2.31280	0.044720	0.0019070	13.3490	0.00015815	1.10705	12.0215	0.0365	12.0580	4.2035	2.038	6.2415	0.00898	0.004485	0.013465	-150.535	-.30645	17.5
17.6	.0914974	2.32404	.044938	.0019162	13.4134	.00015888	1.11216	12.0240	.0368	12.0608	4.2276	2.048	6.2756	.00903	.004506	.013536	-150.486	-.30634	17.6
17.7	.0919394	2.33528	.045156	.0019254	13.4778	.00015961	1.11727	12.0265	.0371	12.0636	4.2517	2.058	6.3097	.00908	.004527	.013607	-150.437	-.30623	17.7
17.8	.0923822	2.34652	.045374	.0019346	13.5422	.00016035	1.12238	12.0290	.0374	12.0664	4.2758	2.068	6.3438	.00913	.004548	.013678	-150.388	-.30612	17.8
17.9	.0928246	2.35776	.045592	.0019438	13.6066	.00016107	1.12749	12.0315	.0377	12.0692	4.2999	2.078	6.3779	.00918	.004569	.013749	-150.339	-.30601	17.9

18.0	0.093267	2.3690	0.04581	0.001953	13.671	0.0001618	1.1326	12.034	0.038	12.072	4.324	2.088	6.412	0.00923	0.004459	0.01382	-156.29	-.3059	18.0
18.1	.0937292	2.38074	.046037	.0019628	13.7396	.0001625?	1.13799	12.0365	.0382	12.0747	4.348	2.0984	6.4464	.00928	.004612	.013892	-150.241	-.3058	18.1
18.2	.0941914	2.39248	.046264	.0019726	13.8082	.0001633?	1.14338	12.0390	.0384	12.0774	4.372	2.1088	6.4808	.00933	.004634	.013964	-150.192	-.3057	18.2
18.3	.0946536	2.40422	.046491	.0019824	13.8768	.0001641?	1.14777	12.0415	.0386	12.0801	4.396	2.1192	6.5152	.00938	.004656	.014036	-150.143	-.3056	18.3
18.4	.0951158	2.41596	.046718	.0019922	13.9454	.0001648?	1.15416	12.0440	.0388	12.0828	4.420	2.1296	6.5496	.00943	.004678	.014108	-150.094	-.3055	18.4
18.5	0.0955780	2.42770	0.046945	0.0020020	14.0140	0.0001656?	1.15955	12.0465	0.0390	12.0855	4.444	2.1400	6.5840	0.00948	0.004700	0.014180	-150.045	-.3054	18.5
18.6	.0960402	2.43944	.047172	.0020118	14.0826	.0001664?	1.16494	12.0490	.0392	12.0882	4.468	2.1504	6.6184	.00953	.004722	.014252	-149.996	-.3053	18.6
18.7	.0965024	2.45118	.047399	.0020216	14.1512	.0001671?	1.17033	12.0515	.0394	12.0909	4.492	2.1608	6.6528	.00958	.004744	.014324	-149.947	-.3052	18.7
18.8	.0969646	2.46292	.047626	.0020314	14.2198	.0001679?	1.17572	12.0540	.0396	12.0936	4.516	2.1712	6.6872	.00963	.004766	.014396	-149.898	-.3051	18.8
18.9	.0974268	2.47466	.047853	.0020412	14.2884	.0001687?	1.18111	12.0565	.0398	12.0963	4.540	2.1816	6.7216	.00968	.004788	.014468	-149.849	-.3050	18.9
19.0	0.097889	2.4864	0.04808	0.0020511	14.357	0.0001695	1.1865	12.059	0.040	12.099	4.564	2.192	6.756	.00973	0.004811	0.01454	-149.80	-.3049	19.0
19.1	.0983721	2.49867	.048317	.0020611	14.4277	.0001703	1.1921	12.0615	.0402	12.1017	4.588	2.203	6.791	.00978	.004833	.014613	-149.751	-.3048	19.1
19.2	.0988552	2.51094	.048554	.0020712	14.4984	.0001711	1.1977	12.0640	.0404	12.1044	4.612	2.214	6.826	.00983	.004856	.014686	-149.702	-.3047	19.2
19.3	.0993383	2.52321	.048791	.0020813	14.5691	.0001719	1.2033	12.0665	.0406	12.1071	4.636	2.225	6.861	.00988	.004879	.014759	-149.653	-.3046	19.3
19.4	.0998214	2.53548	.049028	.0020914	14.6398	.0001727	1.2089	12.0690	.0408	12.1098	4.660	2.236	6.896	.00993	.004902	.014832	-149.604	-.3045	19.4
19.5	0.1003045	2.54715	0.049265	0.0021015	14.7105	0.0001735	1.2145	12.0715	0.0410	12.1125	4.684	2.247	6.931	.00998	0.004925	0.014905	-149.555	-.3044	19.5
19.6	.1007876	2.56002	.049502	.0021116	14.7812	.0001743	1.2201	12.0740	.0412	12.1152	4.708	2.258	6.966	.01003	.004948	.014978	-149.506	-.3043	19.6
19.7	.1012707	2.57229	.049737	.0021217	14.8519	.0001751	1.2257	12.0765	.0414	12.1179	4.732	2.269	7.001	.01008	.004971	.015051	-149.457	-.3042	19.7
19.8	.1017538	2.58456	.049976	.0021318	14.9226	.0001759	1.2313	12.0790	.0416	12.1206	4.756	2.280	7.036	.01013	.004994	.015124	-149.408	-.3041	19.8
19.9	.1022369	2.59683	.050213	.0021419	14.9933	.0001767	1.2369	12.0815	.0418	12.1233	4.780	2.291	7.071	.01018	.005017	.015197	-149.359	-.3040	19.9
20.0	.10272	2.6091	0.05045	0.0021521	15.064	0.0001775	1.2425	12.084	0.042	12.126	4.804	2.302	7.106	0.01023	0.00504	0.01527	-149.310	-.3039	20.0
20.1	.1032225	2.62193	.0506498	.0021626	15.1382	.0001783?	1.24838	12.0866	.0422	12.1288	4.828	2.3134	7.1414	.01028	.005064	.015344	-149.261	-.3038	20.1
20.2	.1037301	2.63476	.0509946	.0021732	15.2124	.0001791?	1.25426	12.0892	.0424	12.1316	4.852	2.3248	7.1768	.01033	.005088	.015418	-149.212	-.3037	20.2
20.3	.1042375	2.64759	.0511394	.0021838	15.2866	.0001800?	1.26014	12.0918	.0426	12.1344	4.876	2.3362	7.2122	.01038	.005112	.015492	-149.163	-.3036	20.3
20.4	.1047440	2.66042	.0513442	.0021944	15.3608	.0001808?	1.26602	12.0944	.0428	12.1372	4.900	2.3476	7.2476	.01043	.005136	.015566	-149.114	-.3035	20.4
20.5	.1052495	2.67325	0.0516905	0.0022050	15.4350	0.0001817?	1.27190	12.0970	0.0430	12.1400	4.924	2.3590	7.2830	0.01048	0.005160	0.015640	-149.065	-.3034	20.5
20.6	.1057550	2.68608	.0519386	.0022156	15.5092	.0001825?	1.27778	12.0996	.0432	12.1428	4.948	2.3704	7.3184	.01053	.005184	.015714	-149.016	-.3033	20.6
20.7	.1062555	2.69891	.0521886	.0022262	15.5834	.0001833?	1.28366	12.1022	.0434	12.1456	4.972	2.3818	7.3538	.01058	.005208	.015788	-148.967	-.3032	20.7
20.8	.1067604	2.71174	.0524434	.0022368	15.6576	.0001842?	1.28954	12.1048	.0436	12.1484	4.996	2.3932	7.3892	.01063	.005232	.015862	-148.918	-.3031	20.8
20.9	.1072654	2.72457	.0526982	.0022474	15.7318	.0001850?	1.29542	12.1074	.0438	12.1512	5.020	2.4046	7.4246	.01068	.005256	.015936	-148.869	-.3030	20.9
21.0	.10777	2.7374	0.05293	0.0022578	15.806	0.0001859	1.3013	12.110	0.044	12.154	5.044	2.416	7.460	0.01073	0.00528	0.01601	-148.82	-.3029	21.0
21.1	.1082698	2.75101	.0531889	.0022691	15.8837	.0001867?	1.30732	12.1125	.0442	12.1567	5.068	2.428	7.496	.01078	.005305	.016085	-148.771	-.30279	21.1
21.2	.1088266	2.76442	.0534488	.0022802	15.9614	.0001876?	1.31334	12.1150	.0444	12.1594	5.092	2.440	7.532	.01083	.005330	.016160	-148.722	-.30268	21.2
21.3	.1093854	2.77783	.0537087	.0022913	16.0391	.0001884?	1.31936	12.1175	.0446	12.1621	5.116	2.452	7.568	.01088	.005355	.016235	-148.673	-.30257	21.3
21.4	.1098882	2.79124	.0539666	.0023024	16.1168	.0001893?	1.32538	12.1200	.0448	12.1648	5.140	2.464	7.604	.01093	.005380	.016310	-148.624	-.30246	21.4
21.5	.1104110	2.80465	0.0542255	0.0023135	16.1945	0.0001902?	1.33140	12.1225	0.0450	12.1675	5.164	2.476	7.640	0.01098	0.005405	0.016385	-148.575	-.30235	21.5
21.6	.1109338	2.81806	.0544884	.0023246	16.2722	.0001910?	1.33742	12.1250	.0452	12.1702	5.188	2.488	7.676	.01103	.005430	.016460	-148.526	-.30224	21.6
21.7	.1114466	2.83147	.0547543	.0023357	16.3499	.0001919?	1.34344	12.1275	.0454	12.1729	5.212	2.500	7.712	.01108	.005455	.016535	-148.477	-.30213	21.7
21.8	.1119594	2.84488	.0550002	.0023468	16.4276	.0001927?	1.34946	12.1300	.0456	12.1756	5.236	2.512	7.748	.01113	.005480	.016610	-148.428	-.30202	21.8
21.9	.1125722	2.85829	.0552461	.0023579	16.5053	.0001936?	1.35548	12.1325	.0458	12.1783	5.260	2.524	7.784	.01118	.005505	.016685	-148.379	-.30191	21.9
22.0	0.1130549	2.8715	0.05552	0.0023691	16.583	0.0001945	1.3615	12.135	0.046	12.181	5.284	2.536	7.820	0.01123	0.00553	0.01676	-148.33	-.3018	22.0
22.1	.1136061	2.88567	.0557591	.0023806	16.6642	.0001954	1.3678	12.1375	.0463	12.1838	5.3081	2.5485	7.8566	.01128	.005556	.016836	-148.281	-.3017	22.1
22.2	.1141152	2.89966	.0560668	.0023922	16.7454	.0001963	1.3741	12.1400	.0466	12.1866	5.3322	2.5610	7.8932	.01133	.005582	.016912	-148.232	-.3016	22.2
22.3	.1147103	2.91365	.0563333	.0024038	16.8266	.0001972	1.3804	12.1425	.0469	12.1894	5.3563	2.5735	7.9298	.01138	.005608	.016988	-148.183	-.3015	22.3
22.4	.1152154	2.92764	.0566044	.0024154	16.9078	.0001981	1.3867	12.1450	.0472	12.1922	5.3804	2.5860	7.9664	.01143	.005634	.017064	-148.134	-.3014	22.4

22.5	0.115805	2.94163	0.056875	0.0024270	16.9890	0.0001990	1.3930	12.1475	0.0475	12.1950	5.4045	2.5985	8.0030	0.01148	0.005660	0.017140	-148.085	-.3013	22.5
22.6	.116356	2.95562	.057146	.0024886	17.0702	.0001999	1.3993	12.1500	.0478	12.1978	5.4286	2.6110	8.0396	.01153	.005686	.017216	-148.036	-.3012	22.6
22.7	.116970	2.96961	.057417	.0024502	17.1514	.0002008	1.4056	12.1525	.0481	12.2006	5.4527	2.6235	8.0762	.01158	.005712	.017292	-147.987	-.3011	22.7
22.8	.117458	2.98360	.057688	.0024618	17.2326	.0002017	1.4119	12.1550	.0484	12.2034	5.4768	2.6360	8.1128	.01163	.005738	.017368	-147.938	-.3010	22.8
22.9	.118009	2.99759	.057959	.0024734	17.3138	.0002026	1.4182	12.1575	.0487	12.2062	5.5009	2.6485	8.1494	.01168	.005764	.017444	-147.889	-.3009	22.9
23.0	0.11856	3.0114	0.05823	0.002485	17.395	0.0002035	1.4245	12.160	0.049	12.209	5.525	2.661	8.186	0.01173	0.005790	0.01752	-147.84	-.3008	23.0
23.1	.119135	3.02601	.058512	.0024971	17.4797	.0002044	1.43115	12.1626	.0492	12.2118	5.549	2.6741	8.2231	.01178	.005818	.017598	-147.79	-.3007	23.1
23.2	.119710	3.04062	.058794	.0025092	17.5644	.0002054	1.43780	12.1652	.0494	12.2146	5.573	2.6872	8.2602	.01183	.005846	.017676	-147.74	-.3006	23.2
23.3	.120285	3.05563	.059076	.0025213	17.6491	.0002063	1.44445	12.1678	.0496	12.2174	5.597	2.7003	8.2973	.01188	.005874	.017754	-147.69	-.3005	23.3
23.4	.120860	3.06984	.059358	.0025334	17.7338	.0002073	1.45110	12.1704	.0498	12.2202	5.621	2.7134	8.3344	.01193	.005902	.017832	-147.64	-.3004	23.4
23.5	0.121435	3.08445	0.059646	0.0025455	17.8185	0.0002082	1.45775	12.1730	0.0500	12.2230	5.645	2.7265	8.3715	0.01198	0.005930	0.017910	-147.59	-.3003	23.5
23.6	.122010	3.09906	.059922	.0025576	17.9032	.0002092	1.46440	12.1756	.0502	12.2258	5.669	2.7396	8.4086	.01203	.005958	.017988	-147.54	-.3002	23.6
23.7	.122585	3.11367	.060204	.0025697	17.9879	.0002101	1.47105	12.1782	.0504	12.2286	5.693	2.7527	8.4457	.01208	.005986	.018066	-147.49	-.3001	23.7
23.8	.123160	3.12828	.060486	.0025818	18.0726	.0002111	1.47770	12.1808	.0506	12.2314	5.717	2.7658	8.4828	.01213	.006014	.018144	-147.44	-.3000	23.8
23.9	.123735	3.14289	.060768	.0025939	18.1573	.0002120	1.48435	12.1834	.0508	12.2342	5.741	2.7789	8.5199	.01218	.006042	.018222	-147.39	-.2999	23.9
24.0	0.12431	3.1575	0.06105	0.002606	18.242	0.0002130	1.4910	12.186	0.051	12.237	5.765	2.792	8.557	0.01223	0.00607	0.01830	-147.34	-.2998	24.0
24.1	.124911	3.17274	.061345	.0026187	18.3309	.0002139	1.49788	12.1885	.0513	12.2398	5.789	2.8057	8.5947	.01228	.006098	.018378	-147.291	-.2997	24.1
24.2	.125512	3.18798	.061640	.0026314	18.4198	.0002149	1.50476	12.1910	.0516	12.2426	5.813	2.8194	8.6324	.01233	.006126	.018456	-147.242	-.2996	24.2
24.3	.126113	3.20322	.061935	.0026441	18.5087	.0002159	1.51164	12.1935	.0519	12.2454	5.837	2.8331	8.6701	.01238	.006154	.018534	-147.193	-.2995	24.3
24.4	.126714	3.21846	.062230	.0026568	18.5976	.0002169	1.51852	12.1960	.0522	12.2482	5.861	2.8468	8.7078	.01243	.006182	.018612	-147.144	-.2994	24.4
24.5	0.127315	3.23370	0.062525	0.0026695	18.6865	0.0002179	1.52540	12.1985	0.0525	12.2510	5.885	2.8605	8.7455	0.01248	0.006210	0.01869	-147.095	-.2993	24.5
24.6	.127916	3.24894	.062820	.0026822	18.7754	.0002188	1.53228	12.2010	.0528	12.2538	5.909	2.8742	8.7832	.01253	.006238	.018768	-147.046	-.2992	24.6
24.7	.128517	3.26418	.063115	.0026949	18.8643	.0002198	1.53916	12.2035	.0531	12.2566	5.933	2.8879	8.8209	.01258	.006266	.018846	-146.997	-.2991	24.7
24.8	.129118	3.27947	.063410	.0027076	18.9532	.0002208	1.54604	12.2060	.0534	12.2594	5.957	2.9016	8.8586	.01263	.006294	.018924	-146.948	-.2990	24.8
24.9	.129719	3.29466	.063705	.0027203	19.0421	.0002218	1.55292	12.2085	.0537	12.2622	5.981	2.9153	8.8963	.01268	.006322	.019002	-146.899	-.2989	24.9
25.0	0.13032	3.3099	0.06400	0.002733	19.131	0.0002228	1.5598	12.211	0.054	12.265	6.005	2.929	8.934	0.01273	0.00635	0.01908	-146.85	-.2988	25.0
25.1	.130947	3.32585	.064308	.0027462	19.2234	.0002238	1.56699	12.2135	.0543	12.2678	6.029	2.9433	8.9723	.012779	.00638	.019159	-146.80	-.29869	25.1
25.2	.131574	3.34180	.064616	.0027594	19.3158	.0002248	1.57418	12.2160	.0546	12.2706	6.053	2.9576	9.0106	.012828	.00641	.019238	-146.75	-.29858	25.2
25.3	.132201	3.35775	.064924	.0027726	19.4082	.0002258	1.58137	12.2185	.0549	12.2734	6.077	2.9719	9.0489	.012877	.00644	.019317	-146.70	-.29847	25.3
25.4	.132828	3.37370	.065232	.0027858	19.5006	.0002269	1.58856	12.2210	.0552	12.2762	6.101	2.9862	9.0872	.012926	.00647	.019396	-146.65	-.29836	25.4
25.5	0.133455	3.38965	0.065540	0.0027990	19.5930	0.0002279	1.59575	12.2235	0.0555	12.2790	6.125	3.0005	9.1255	0.012975	0.00650	0.019475	-146.60	-.29825	25.5
25.6	.134082	3.40560	.065848	.0028122	19.6854	.0002289	1.60294	12.2260	.0558	12.2818	6.149	3.0148	9.1638	.013024	.00653	.019554	-146.55	-.29814	25.6
25.7	.134709	3.42155	.066156	.0028254	19.7778	.0002300	1.61013	12.2285	.0561	12.2846	6.173	3.0291	9.2021	.013073	.00656	.019633	-146.50	-.29803	25.7
25.8	.135336	3.43750	.066464	.0028386	19.8702	.0002310	1.61732	12.2310	.0564	12.2874	6.197	3.0434	9.2404	.013122	.00659	.019712	-146.45	-.29792	25.8
25.9	.135963	3.45345	.066772	.0028518	19.9626	.0002320	1.62451	12.2335	.0567	12.2902	6.221	3.0577	9.2787	.013171	.00662	.019791	-146.40	-.29781	25.9
26.0	0.13659	3.4694	0.06708	0.002865	20.053	0.0002331	1.6317	12.236	0.057	12.293	6.245	3.072	9.317	0.01322	0.00665	0.01987	-146.35	-.2977	26.0
26.1	.137244	3.48601	.067407	.0028788	20.1516	.0002341	1.63917	12.2386	.0572	12.2958	6.269	3.0869	9.3559	.01327	.006681	.019951	-146.30	-.2976	26.1
26.2	.137858	3.50262	.067724	.0028926	20.2482	.0002352	1.64654	12.2412	.0574	12.2986	6.293	3.1018	9.3948	.01332	.006712	.020032	-146.25	-.2975	26.2
26.3	.138557	3.51923	.068046	.0029064	20.3448	.0002362	1.65396	12.2438	.0576	12.3014	6.317	3.1167	9.4337	.01337	.006743	.020113	-146.20	-.2974	26.3
26.4	.139206	3.53584	.068368	.0029202	20.4414	.0002373	1.66138	12.2464	.0578	12.3042	6.341	3.1316	9.4726	.01342	.006774	.020194	-146.15	-.2973	26.4
26.5	0.139860	3.55245	0.068690	0.0029340	20.5380	0.0002384	1.66880	12.2490	0.0580	12.3070	6.365	3.1465	9.5115	0.01347	0.006805	0.020275	-146.10	-.2972	26.5
26.6	.140514	3.56906	.069017	.0029478	20.6346	.0002394	1.67622	12.2516	.0582	12.3098	6.389	3.1614	9.5504	.01352	.006836	.020356	-146.05	-.2971	26.6
26.7	.141168	3.58567	.069334	.0029616	20.7312	.0002405	1.68364	12.2542	.0584	12.3126	6.413	3.1763	9.5893	.01357	.006867	.020437	-146.00	-.2970	26.7
26.8	.141822	3.60228	.069656	.0029754	20.8278	.0002415	1.69106	12.2568	.0586	12.3154	6.437	3.1912	9.6282	.01362	.006898	.020518	-145.95	-.2969	26.8
26.9	.142476	3.61889	.069978	.0029892	20.9244	.0002426	1.69848	12.2594	.0588	12.3182	6.461	3.2061	9.6671	.01367	.006929	.020599	-145.90	-.2968	26.9

27.0	0.14313	3.6355	0.07030	0.003003	21.021	0.0002437	1.7059	12.262	0.059	12.321	6.485	3.221	9.706	0.01372	0.00696	0.02068	-145.85	-.2987	27.0
27.1	.143813	3.65285	.070635	.0030174	21.1218	.00024481	1.71367	12.2645	.0593	12.3238	6.5091	3.2366	9.7457	.013769	.006992	.020761	-145.801	-.2966	27.1
27.2	.144496	3.67020	.070970	.0030318	21.2226	.00024592	1.72144	12.2670	.0596	12.3266	6.5332	3.2522	9.7854	.013818	.007024	.020847	-145.752	-.2965	27.2
27.3	.145179	3.68755	.071305	.0030462	21.3234	.00024703	1.72921	12.2695	.0599	12.3294	6.5573	3.2678	9.8251	.013867	.007056	.020923	-145.703	-.2964	27.3
27.4	.145862	3.70490	.071640	.0030606	21.4242	.00024814	1.73698	12.2720	.0602	12.3322	6.5814	3.2834	9.8648	.013916	.007088	.021004	-145.654	-.2963	27.4
27.5	0.146545	3.72225	0.071975	0.0030750	21.5250	0.00024925	1.74475	12.2745	0.0605	12.3350	6.6055	3.2990	9.9045	0.013962	0.007120	0.021085	-145.605	-.2962	27.5
27.6	.147228	3.73960	.072310	.0030894	21.6258	.00025036	1.75252	12.2770	.0608	12.3378	6.6296	3.3146	9.9442	.014014	.007152	.021166	-145.556	-.2961	27.6
27.7	.148011	3.75695	.072645	.0031038	21.7266	.00025147	1.76029	12.2795	.0611	12.3406	6.6537	3.3302	9.9839	.014063	.007184	.021247	-145.507	-.2960	27.7
27.8	.148694	3.77430	.072980	.0031182	21.8274	.00025258	1.76806	12.2820	.0614	12.3434	6.6778	3.3458	10.0236	.014112	.007216	.021328	-145.458	-.2959	27.8
27.9	.149377	3.79165	.073315	.0031326	21.9282	.00025369	1.77583	12.2845	.0617	12.3462	6.7019	3.3614	10.0633	.014161	.007248	.021409	-145.409	-.2958	27.9
28.0	0.14996	3.8090	0.07365	0.003147	22.029	0.0002548	1.7836	12.287	0.062	12.349	6.726	3.377	10.103	0.01421	0.00728	0.02149	-145.36	-.2957	28.0
28.1	.150673	3.82689	.07400	.003162	22.1338	.00025593	1.79151	12.2895	.0623	12.3518	6.7500	3.3933	10.1433	.014259	.007313	.021572	-145.31	-.2956	28.1
28.2	.151386	3.84478	.07435	.003177	22.2386	.00025706	1.79942	12.2920	.0626	12.3546	6.7740	3.4096	10.1836	.014308	.007346	.021654	-145.26	-.2955	28.2
28.3	.152099	3.86267	.07470	.003192	22.3434	.00025819	1.80733	12.2945	.0629	12.3574	6.7980	3.4259	10.2239	.014357	.007379	.021736	-145.21	-.2954	28.3
28.4	.152812	3.88056	.07505	.003207	22.4482	.00025932	1.81524	12.2970	.0632	12.3602	6.8220	3.4422	10.2642	.014406	.007412	.021818	-145.16	-.2953	28.4
28.5	0.153525	3.89845	0.07540	0.003222	22.5530	0.0002604S	1.82315	12.2995	0.0635	12.3630	6.8460	3.4585	10.3045	0.014455	0.007445	0.021900	-145.11	-.2952	28.5
28.6	.154238	3.91634	.07575	.003237	22.6578	.00026158	1.83106	12.3020	.0638	12.3658	6.8700	3.4748	10.3448	.014504	.007478	.021982	-145.06	-.2951	28.6
28.7	.154951	3.93423	.07610	.003252	22.7626	.00026271	1.83897	12.3045	.0641	12.3686	6.8940	3.4911	10.3851	.014552	.007511	.022064	-145.01	-.2950	28.7
28.8	.155664	3.95212	.07645	.003267	22.8674	.00026384	1.84688	12.3070	.0644	12.3714	6.9180	3.5074	10.4254	.014602	.007544	.022146	-144.96	-.2949	28.8
28.9	.156377	3.97001	.07680	.003282	22.9722	.00026497	1.85479	12.3095	.0647	12.3742	6.9420	3.5237	10.4657	.014651	.007577	.022228	-144.91	-.2948	28.9
29.0	0.15709	3.9879	0.07715	0.003297	23.077	0.0002661	1.8627	12.312	0.065	12.377	6.966	3.540	10.506	0.01470	0.00761	0.02231	-144.86	-.2947	29.0
29.1	.157833	4.00699	.077515	.0033127	23.1871	.00026733	1.87131	12.3146	.0653	12.3799	6.990	3.5569	10.5469	.014749	.007645	.022394	-144.81	-.29459	29.1
29.2	.158576	4.02608	.077880	.0033284	23.2972	.00026856	1.87992	12.3172	.0656	12.3828	7.014	3.5738	10.5878	.014798	.007680	.022478	-144.76	-.29448	29.2
29.3	.159319	4.04517	.078245	.0033441	23.4073	.00026979	1.88853	12.3198	.0659	12.3859	7.038	3.5907	10.6287	.014847	.007715	.022562	-144.71	-.29437	29.3
29.4	.160062	4.06426	.078610	.0033598	23.5174	.00027109	1.89714	12.3224	.0662	12.3886	7.062	3.6076	10.6696	.014896	.007750	.022646	-144.66	-.29426	29.4
29.5	0.160805	4.08335	0.078975	0.0033755	23.6275	0.00027225	1.90575	12.3250	0.0665	12.3915	7.086	3.6245	10.7105	0.014945	0.007785	0.022730	-144.61	-.29415	29.5
29.6	.161548	4.10244	.079340	.0033912	23.7376	.00027348	1.91436	12.3276	.0668	12.3944	7.110	3.6414	10.7514	.014994	.007820	.022814	-144.56	-.29404	29.6
29.7	.162291	4.12153	.079705	.0034069	23.8477	.00027471	1.92297	12.3302	.0671	12.3973	7.134	3.6583	10.7923	.015043	.007855	.022898	-144.51	-.29393	29.7
29.8	.163034	4.14062	.080070	.0034226	23.9578	.00027594	1.93158	12.3328	.0674	12.4002	7.158	3.6752	10.8332	.015092	.007890	.022982	-144.46	-.29382	29.8
29.9	.163777	4.15971	.080435	.0034383	24.0679	.00027717	1.94019	12.3354	.0677	12.4031	7.182	3.6921	10.8741	.015141	.007925	.023066	-144.41	-.29371	29.9
30.0	0.16452	4.1788	0.08080	0.003454	24.178	0.0002784	1.9488	12.338	0.068	12.406	7.206	3.709	10.915	0.01519	0.00796	0.02315	-144.36	-.2936	30.0
30.1	.165295	4.19829	.081181	.0034703	24.2921	.00027965	1.95755	12.3405	.0683	12.4088	7.230	3.7268	10.9568	.015239	.007996	.023235	-144.31	-.2935	30.1
30.2	.166070	4.21818	.081562	.0034866	24.4062	.00028090	1.96630	12.3430	.0686	12.4116	7.254	3.7446	10.9986	.015288	.008032	.023320	-144.26	-.2934	30.2
30.3	.166845	4.23787	.081943	.0035029	24.5203	.00028215	1.97505	12.3455	.0689	12.4144	7.278	3.7624	11.0404	.015337	.008068	.023405	-144.21	-.2933	30.3
30.4	.167620	4.25756	.082324	.0035192	24.6344	.00028340	1.98380	12.3480	.0692	12.4172	7.302	3.7802	11.0822	.015386	.008104	.023490	-144.16	-.2932	30.4
30.5	0.168395	4.27725	0.082705	0.003535S	24.7485	0.00028465	1.99255	12.3505	0.0695	12.4200	7.326	3.7980	11.1240	0.015435	0.008140	0.023575	-144.11	-.2931	30.5
30.6	.169170	4.29694	.083086	.0035518	24.8626	.00028590	2.00130	12.3530	.0698	12.4228	7.350	3.8158	11.1658	.015484	.008176	.023660	-144.06	-.2930	30.6
30.7	.169945	4.31663	.083467	.0035681	24.9767	.00028715	2.01005	12.3555	.0701	12.4256	7.374	3.8336	11.2076	.015533	.008212	.023745	-144.01	-.2929	30.7
30.8	.170720	4.33632	.083848	.0035844	25.0908	.00028840	2.01880	12.3580	.0704	12.4284	7.398	3.8514	11.2494	.015582	.008247	.023830	-143.96	-.2928	30.8
30.9	.171495	4.35601	.084229	.0036007	25.2049	.00028965	2.02755	12.3605	.0707	12.4312	7.422	3.8692	11.2912	.015631	.008284	.023915	-143.91	-.2927	30.9
31.0	0.17271	4.3757	0.08461	0.003617	25.319	0.0002909	2.0363	12.363	0.071	12.434	7.446	3.887	11.333	0.01568	0.00832	0.02400	-143.86	-.2926	31.0
31.1	.173078	4.39621	.085007	.0036341	25.4387	.0002922	2.0454	12.3655	.0714	12.4369	7.470	3.9055	11.3755	.015689	.008358	.024087	-143.81	-.2925	31.1
31.2	.173886	4.41672	.085404	.0036512	25.5584	.0002935	2.0545	12.3680	.0718	12.4398	7.494	3.9240	11.4180	.015778	.008396	.024174	-143.76	-.2924	31.2
31.3	.174694	4.43723	.085801	.0036683	25.6781	.0002948	2.0636	12.3705	.0722	12.4427	7.518	3.9425	11.4605	.015827	.008434	.024261	-143.71	-.2923	31.3
31.4	.175502	4.45774	.086198	.0036854	25.7978	.0002961	2.0727	12.3730	.0726	12.4456	7.542	3.9610	11.5030	.015876	.008477	.024348	-143.66	-.2922	31.4

31.5	0.176310	4.47825	0.086595	0.0037025	25.9175	0.0002974	2.0818	12.3755	0.0730	12.4485	7.566	3.9795	11.5455	0.015925	0.008510	0.024435	-143.61	-.2921	31.5
31.6	.177118	4.49876	.086992	.0037196	26.0372	.0002987	2.0909	12.3780	.0734	12.4514	7.590	3.9980	11.5880	.015974	.008548	.024522	-143.56	-.2920	31.6
31.7	.177926	4.51927	.087389	.0037367	26.1569	.0003000	2.1000	12.3805	.0738	12.4543	7.614	4.0165	11.6305	.016023	.008586	.024609	-143.51	-.2919	31.7
31.8	.178734	4.53978	.087786	.0037538	26.2766	.0003013	2.1091	12.3830	.0742	12.4572	7.638	4.0350	11.6730	.016072	.008624	.024696	-143.46	-.2918	31.8
31.9	.179547	4.56029	.088183	.0037709	26.3963	.0003026	2.1182	12.3855	.0746	12.4601	7.662	4.0535	11.7155	.016121	.008662	.024783	-143.41	-.2917	31.9
32.0	0.18035	4.5808	0.08858	0.003788	26.516	0.0003039	2.1273	12.388	0.075	12.463	7.686	4.072	11.758	0.01617	0.00870	0.02487	-143.36	-.2916	32.0
32.0	0.18037	4.5814	0.088586	0.003788	26.516	0.0003039	2.1273	12.388	0.075	12.463	7.686	4.072	11.758	0.01617	0.00870	0.02487	0.04	0.0000	32.0
32.1	.181117	4.60022	.0889501	.0038036	26.6252	.0003050 8	2.13556	12.3905	.0754	12.4659	7.7101	4.089	11.7991	.016219	.008734	.024953	.141	.0002	32.1
32.2	.181854	4.61904	.0893142	.0038192	26.7344	.0003062 6	2.14382	12.3930	.0758	12.4688	7.7342	4.106	11.8402	.016268	.008768	.025036	.242	.0004	32.2
32.3	.182596	4.63786	.0896783	.0038348	26.8436	.0003074 4	2.15208	12.3955	.0762	12.4717	7.7583	4.123	11.8813	.016317	.008802	.025119	.343	.0006	32.3
32.4	.183338	4.65668	.0900424	.0038504	26.9528	.0003086 2	2.16034	12.3980	.0766	12.4746	7.7824	4.140	11.9224	.016366	.008836	.025202	.444	.0008	32.4
32.5	0.184080	4.67550	0.0904065	0.0038660	27.0620	0.0003098 0	2.16860	12.4005	0.0770	12.4775	7.8065	4.157	11.9635	0.016415	0.008870	0.025285	0.545	0.0010	32.5
32.6	.184822	4.69432	.0907706	.0038816	27.1712	.0003109 8	2.17686	12.4030	.0774	12.4804	7.8306	4.174	12.0046	.016464	.008904	.025368	.646	.0012	32.6
32.7	.185564	4.71314	.0911347	.0038972	27.2804	.0003121 6	2.18512	12.4055	.0778	12.4833	7.8547	4.191	12.0457	.016513	.008938	.025451	.747	.0014	32.7
32.8	.186306	4.73196	.0914988	.0039128	27.3896	.0003133 4	2.19338	12.4080	.0782	12.4862	7.8788	4.208	12.0868	.016562	.008972	.025534	.848	.0016	32.8
32.9	.187048	4.75078	.0918629	.0039284	27.4988	.0003145 2	2.20164	12.4105	.0786	12.4891	7.9029	4.225	12.1279	.016611	.009006	.025617	.949	.0018	32.9
33.0	0.18778	4.7696	0.092227	0.003944	27.608	0.0003157 0	2.2099	12.413	0.079	12.492	7.927	4.242	12.169	0.01666	0.00904	0.02570	1.05	0.002	33.0
33.1	.188548	4.78911	.0926042	.0039603	27.7221	.0003169 3	2.21851	12.4155	.0793	12.4948	7.951	4.2596	12.2106	.016709	.009076	.025785	1.151	.00221	33.1
33.2	.189316	4.80862	.0929814	.0039766	27.8362	.0003181 6	2.22712	12.4180	.0796	12.4976	7.975	4.2772	12.2522	.016758	.009112	.025870	1.252	.00242	33.2
33.3	.190084	4.82813	.0933586	.0039929	27.9503	.0003193 9	2.23573	12.4205	.0799	12.5004	7.999	4.2948	12.2938	.016807	.009148	.025955	1.353	.00263	33.3
33.4	.190852	4.84764	.0937358	.0040092	28.0644	.0003220 6 2	2.24434	12.4230	.0802	12.5032	8.023	4.3124	12.3354	.016856	.009184	.026040	1.454	.00284	33.4
33.5	0.191620	4.86715	0.0941130	0.0040255	28.1785	0.0003218 5	2.25295	12.4255	0.0805	12.5060	8.047	4.3300	12.3770	0.016905	0.009220	0.026125	1.555	0.00305	33.5
33.6	.192388	4.88666	.0944902	.0040418	28.2926	.0003230 8	2.26156	12.4280	.0808	12.5088	8.071	4.3476	12.4186	.016954	.009256	.026251	1.656	.00326	33.6
33.7	.193156	4.90617	.0948674	.0040581	28.4067	.0003243 1	2.27017	12.4305	.0811	12.5116	8.095	4.3652	12.4602	.017003	.009292	.026295	1.757	.00347	33.7
33.8	.193924	4.92568	.0952446	.0040744	28.5208	.0003255 4	2.27818	12.4330	.0814	12.5144	8.119	4.3828	12.5018	.017052	.009328	.026380	1.858	.00368	33.8
33.9	.194692	4.94519	.0956218	.0040907	28.6349	.0003267 7	2.28739	12.4355	.0817	12.5172	8.143	4.4004	12.5434	.017101	.009364	.026465	1.959	.00389	33.9
34.0	0.19546	4.9647	0.095999	0.004107	28.749	0.0003280	2.2960	12.438	0.082	12.520	8.167	4.418	12.585	0.01715	0.00940	0.02655	2.06	0.0041	34.0
34.1	.196256	4.98492	.0963899	.0041238	28.8666	.0003292 7	2.30489	12.4406	.0823	12.5229	8.191	4.4363	12.6273	.017199	.009437	.026636	2.16	.0043	34.1
34.2	.197052	5.00514	.0967808	.0041406	28.9842	.0003305 4	2.31378	12.4432	.0826	12.5258	8.215	4.4546	12.6696	.017248	.009474	.026722	2.26	.0045	34.2
34.3	.197848	5.02536	.0971717	.0041574	29.1018	.0003318 1	2.32267	12.4458	.0829	12.5287	8.239	4.4729	12.7119	.017297	.009511	.026808	2.36	.0047	34.3
34.4	.198644	5.04558	.0975626	.0041742	29.2194	.0003330 8	2.33156	12.4484	.0832	12.5316	8.263	4.4912	12.7542	.017346	.009548	.026894	2.46	.0049	34.4
34.5	0.199440	5.06580	0.0979535	0.0041910	29.3370	0.0003343 5	2.34045	12.4510	0.0835	12.5345	8.287	4.5095	12.7965	0.017395	0.009585	0.026980	2.56	0.0051	34.5
34.6	.200236	5.08602	.0983444	.0042078	29.4546	.0003356 2	2.34934	12.4536	.0838	12.5374	8.311	4.5278	12.8388	.017444	.009622	.027066	2.66	.0053	34.6
34.7	.201032	5.10624	.0987353	.0042246	29.5722	.0003368 9	2.35823	12.4562	.0841	12.5403	8.335	4.5461	12.8811	.017493	.009659	.027152	2.76	.0055	34.7
34.8	.201828	5.12646	.0991262	.0042414	29.6898	.0003381 6	2.36712	12.4588	.0844	12.5432	8.359	4.5644	12.9234	.017542	.009696	.027238	2.86	.0057	34.8
34.9	.202624	5.14668	.0995171	.0042582	29.8074	.0003394 3	2.37601	12.4614	.0847	12.5461	8.383	4.5827	12.9657	.017591	.009733	.027324	2.96	.0059	34.9
35.0	0.20342	5.1669	0.099908	0.004275	29.925	0.0003407	2.3849	12.464	0.085	12.549	8.407	4.601	13.008	0.01764	0.00977	0.02741	3.06	0.0061	35.0
35.1	.204244	5.18783	.1003132	.0042925	30.0475	.0003472 0 1	2.39407	12.4665	.0854	12.5519	8.431	4.620	13.051	.017688	.009809	.027497	3.161	.0063	35.1
35.2	.205068	5.20876	.1007184	.0043100	30.1700	.0003433 2	2.40324	12.4690	.0858	12.5548	8.455	4.639	13.094	.017736	.009848	.027584	3.262	.0065	35.2
35.3	.205892	5.22969	.1011236	.0043275	30.2925	.0003446 3	2.41241	12.4715	.0862	12.5577	8.479	4.658	13.137	.017784	.009887	.027671	3.363	.0067	35.3
35.4	.206716	5.25062	.1015288	.0043450	30.4150	.0003459 4	2.42158	12.4740	.0866	12.5606	8.503	4.677	13.180	.017832	.009926	.027758	3.464	.0069	35.4
35.5	0.207540	5.27155	0.1019340	0.0043625	30.5375	0.0003472 5	2.43075	12.4765	0.0870	12.5635	8.527	4.696	13.223	0.017880	0.009965	0.027845	3.565	0.0071	35.5
35.6	.208364	5.29248	.1023392	.0043800	30.6600	.0003485 6	2.53992	12.4790	.0874	12.5664	8.551	4.715	13.266	.017928	.010004	.027932	3.666	.0073	35.6
35.7	.209188	5.31341	.1027444	.0043975	30.7825	.0003498 7	2.44909	12.4815	.0878	12.5693	8.575	4.734	13.309	.017976	.010043	.028019	3.767	.0075	35.7
35.8	.210012	5.33434	.1031496	.0044150	30.9050	.0003511 8	2.45826	12.4840	.0882	12.5722	8.599	4.753	13.352	.018024	.010082	.028106	3.868	.0077	35.8
35.9	.210836	5.35527	.1035548	.0044325	31.0275	.0003524 9	2.46743	12.4865	.0886	12.5751	8.623	4.772	13.395	.018072	.010121	.028193	3.969	.0079	35.9

36.0	0.21166	5.3762	0.10396	0.004450	31.150	0.0003538	2.4766	12.489	0.089	12.578	8.647	4.791	13.438	0.01817	0.01016	0.02878	4.07	0.0081	36.0
36.1	.212514	5.39789	.104379	.0044681	31.2767	.00035515	2.48605	12.4915	.0894	12.5809	8.671	4.8106	13.4816	.018169	.01020	.028369	4.17	.00831	36.1
36.2	.213368	5.41958	.104798	.0044862	31.4034	.00035650	2.49550	12.4940	.0898	12.5838	8.695	4.8302	13.5252	.018218	.01024	.028458	4.27	.00852	36.2
36.3	.214222	5.44127	.105217	.0045043	31.5301	.00035785	2.50495	12.4965	.0902	12.5867	8.719	4.8498	13.5688	.018267	.01028	.028547	4.37	.00873	36.3
36.4	.215076	5.46296	.105636	.0045224	31.6568	.00035920	2.51440	12.4990	.0906	12.5896	8.743	4.8694	13.6124	.018316	.01032	.028636	4.47	.00894	36.4
36.5	0.215930	5.48465	0.106055	0.0045405	31.7835	0.00036055	2.52385	12.5015	0.0910	12.5925	8.767	4.8890	13.6560	0.018365	0.01036	0.028725	4.57	0.00915	36.5
36.6	.216784	5.50634	.106474	.0045586	31.9102	.00036190	2.53330	12.5040	.0914	12.5954	8.791	4.9086	13.6996	.018414	.01040	.028814	4.67	.00936	36.6
36.7	.217638	5.52803	.106893	.0045767	32.0369	.00036325	2.54275	12.5065	.0918	12.5983	8.815	4.9282	13.7432	.018463	.01044	.028903	4.77	.00957	36.7
36.8	.218492	5.54972	.107312	.0045948	32.1636	.00036460	2.55220	12.5090	.0922	12.6012	8.839	4.9478	13.7868	.018512	.01048	.028992	4.87	.00978	36.8
36.9	.219346	5.57141	.107731	.0046129	32.2903	.00036595	2.56165	12.5115	.0926	12.6041	8.863	4.9674	13.8304	.018561	.01052	.029081	4.97	.00999	36.9
37.0	0.22020	5.5931	0.10815	0.004631	32.417	0.0003673	2.5711	12.514	0.093	12.607	8.887	4.987	13.874	0.01861	0.01056	0.029170	5.07	0.0102	37.0
37.1	.221084	5.61555	.108584	.0046497	32.5479	.0003687	2.5809	12.5166	.0934	12.610	8.8911	5.0074	13.9185	.018658	.010601	.029259	5.171	.0104	37.1
37.2	.221968	5.63800	.109018	.0046684	32.6788	.0003701	2.5907	12.5192	.0938	12.613	8.9352	5.0278	13.9630	.018706	.010647	.029348	5.272	.0106	37.2
37.3	.222852	5.66045	.109452	.0046871	32.8097	.0003715	2.6005	12.5218	.0942	12.616	8.9593	5.0482	14.0075	.018754	.010683	.029437	5.373	.0108	37.3
37.4	.223736	5.68290	.109886	.0047058	32.9406	.0003729	2.6103	12.5244	.0946	12.619	8.9834	5.0686	14.0520	.018802	.010724	.029526	5.474	.0110	37.4
37.5	0.224620	5.70525	0.110320	0.0047245	33.0715	0.0003743	2.6201	12.5270	0.0950	12.622	9.0075	5.0890	14.0965	0.018850	0.010765	0.029615	5.575	0.0112	37.5
37.6	.225504	5.72780	.110754	.0047432	33.2024	.0003757	2.6299	12.5296	.0954	12.625	9.0316	5.1094	14.1410	.018898	.010806	.029704	5.676	.0114	37.6
37.7	.226388	5.75025	.111188	.0047619	33.3333	.0003771	2.6397	12.5322	.0958	12.628	9.0557	5.1298	14.1855	.018946	.010847	.029793	5.777	.0116	37.7
37.8	.227272	5.77270	.111622	.0047806	33.4642	.0003785	2.6495	12.5348	.0962	12.631	9.0798	5.1502	14.2300	.018994	.010888	.029882	5.878	.0118	37.8
37.9	.228156	5.79515	.112056	.0047993	33.5951	.0003799	2.6593	12.5374	.0966	12.634	9.1039	5.1706	14.2745	.019042	.010929	.029971	5.979	.0120	37.9
38.0	0.22904	5.8176	0.11249	0.004818	33.726	0.0003813	2.6691	12.540	0.097	12.637	9.128	5.191	14.319	0.01909	0.01091	0.03006	6.08	0.0122	38.0
38.1	.229951	5.84084	.11294	.0048374	33.8618	.00038274	2.67918	12.5425	.0974	12.6399	9.152	5.2122	14.3642	.019138	.011012	.03015	6.18	.0124	38.1
38.2	.230870	5.86408	.11339	.0048568	33.9976	.00038418	2.68926	12.5450	.0978	12.6428	9.176	5.2334	14.4094	.019186	.011054	.03024	6.28	.0126	38.2
38.3	.231785	5.88732	.11384	.0048762	34.1334	.00038562	2.69934	12.5475	.0982	12.6457	9.200	5.2546	14.4546	.019234	.011096	.03033	6.38	.0128	38.3
38.4	.232700	5.91056	.11429	.0048956	34.2692	.00038706	2.70942	12.5500	.0986	12.6486	9.224	5.2758	14.4998	.019282	.011138	.03042	6.48	.0130	38.4
38.5	0.233615	5.93380	0.11474	0.0049150	34.4050	0.00038850	2.71950	12.5525	0.0990	12.6515	9.248	5.2970	14.5450	0.019330	0.011180	0.03051	6.58	0.0132	38.5
38.6	.234530	5.95704	.11519	.0049344	34.5408	.00038994	2.72958	12.5550	.0994	12.6544	9.272	5.3182	14.5902	.019378	.011222	.03060	6.68	.0134	38.6
38.7	.235445	5.98028	.11564	.0049538	34.6766	.00039138	2.73966	12.5575	.0998	12.6573	9.296	5.3394	14.6354	.019426	.011264	.03069	6.78	.0136	38.7
38.8	.236360	6.00352	.11609	.0049732	34.8124	.00039282	2.74974	12.5600	.1002	12.6602	9.320	5.3606	14.6806	.019474	.011306	.03078	6.88	.0138	38.8
38.9	.237275	6.02676	.11654	.0049926	34.9482	.00039426	2.75982	12.5625	.1006	12.6631	9.344	5.3818	14.7258	.019522	.011348	.03087	6.98	.0140	38.9
39.0	0.23819	6.0500	0.11699	0.005012	35.084	0.0003957	2.7699	12.565	0.101	12.666	9.368	5.403	14.771	0.01957	0.01139	0.03096	7.08	0.0142	39.0
39.1	.239138	6.07408	.117455	.0050321	35.2247	.00039719	2.78033	12.5675	.1014	12.6689	9.392	5.4249	14.8169	.019618	.011434	.031052	7.181	.0144	39.1
39.2	.240086	6.09816	.117920	.0050522	35.3654	.00039868	2.79076	12.5700	.1018	12.6718	9.416	5.4468	14.8628	.019666	.011478	.031144	7.282	.0146	39.2
39.3	.241034	6.12224	.118385	.0050723	35.5061	.00040017	2.80119	12.5725	.1022	12.6747	9.440	5.4687	14.9087	.019714	.011522	.031236	7.383	.0148	39.3
39.4	.241982	6.14632	.118850	.0050924	35.6468	.00040166	2.81162	12.5750	.1026	12.6776	9.464	5.4906	14.9546	.019762	.011566	.031328	7.484	.0150	39.4
39.5	0.242929	6.17040	0.119315	0.0051125	35.7875	0.00040315	2.82205	12.5775	0.1030	12.6805	9.488	5.5125	15.0005	0.019810	0.011610	0.031420	7.585	0.0152	39.5
39.6	.243877	6.19448	.119780	.0051326	35.9282	.00040464	2.83248	12.5800	.1034	12.6834	9.512	5.5344	15.0464	.019858	.011654	.031512	7.686	.0154	39.6
39.7	.244825	6.21856	.120245	.0051527	36.0689	.00040613	2.84291	12.5825	.1038	12.6863	9.536	5.5563	15.0923	.019906	.011698	.031604	7.787	.0156	39.7
39.8	.245773	6.24264	.120710	.0051728	36.2096	.00040762	2.85334	12.5850	.1042	12.6892	9.560	5.5782	15.1382	.019954	.011742	.031696	7.888	.0158	39.8
39.9	.246721	6.26672	.121175	.0051929	36.3503	.00040911	2.86377	12.5875	.1046	12.6921	9.584	5.6001	15.1841	.020002	.011786	.031788	7.989	.0160	39.9
40.0	0.24767	6.2908	0.12164	0.005213	36.491	0.0004106	2.8742	12.590	0.105	12.695	9.608	5.622	15.230	0.02005	0.01183	0.03188	8.09	0.0162	40.0
40.1	.248651	6.31572	.122122	.0052338	36.6366	.00041214	2.88498	12.5926	.1054	12.698	9.632	5.6447	15.2767	.020098	.011875	.031973	8.19	.0164	40.1
40.2	.249632	6.34064	.122604	.0052546	36.7822	.00041368	2.89576	12.5952	.1058	12.701	9.656	5.6674	15.3234	.020146	.011920	.032066	8.29	.0166	40.2
40.3	.250613	6.36556	.123086	.0052754	36.9278	.00041522	2.90654	12.5978	.1062	12.704	9.680	5.6901	15.3701	.020194	.011965	.032159	8.39	.0168	40.3
40.4	.251594	6.39048	.123568	.0052962	37.0734	.00041676	2.91732	12.6004	.1066	12.707	9.704	5.7128	15.4168	.020242	.012010	.032259	8.49	.0170	40.4

40.5	0.252575	6.41540	0.124050	0.0053170	37.2190	0.00041830	2.92810	12.6030	0.1070	12.710	9.728	5.7355	15.4635	0.020290	0.012055	0.032345	8.59	0.0172	40.5
40.6	.253556	6.44032	.124532	.0053378	37.3646	.00041984	2.93888	12.6056	.1074	12.713	9.752	5.7582	15.5102	.020338	.012100	.032438	8.69	.0174	40.6
40.7	.254537	6.46524	.125014	.0053586	37.5102	.00042138	2.94966	12.6082	.1078	12.716	9.776	5.7809	15.5569	.020386	.012145	.032531	8.79	.0176	40.7
40.8	.255518	6.49016	.125496	.0053794	37.6558	.00042292	2.96044	12.6108	.1082	12.719	9.800	5.8036	15.6036	.020434	.012190	.032624	8.89	.0178	40.8
40.9	.256499	6.51508	.125978	.0054002	37.8014	.00042446	2.97122	12.6134	.1086	12.722	9.824	5.8263	15.6503	.020482	.012235	.032717	8.98	.0180	40.9
41.0	0.25748	6.5400	0.12646	0.005421	37.947	0.0004260	2.9820	12.616	0.109	12.725	9.848	5.849	15.657	0.02053	0.01228	0.03281	9.09	0.0182	41.0
41.1	.258495	6.56578	.126959	.0054427	38.0989	.00042760	2.99321	12.6185	.1095	12.728	9.872	5.8725	15.7445	.020578	.012327	.032905	9.181	.0184	41.1
41.2	.259510	6.59156	.127458	.0054644	38.2508	.00042927	3.00442	12.6210	.1100	12.731	9.896	5.8960	15.7920	.020626	.012374	.033000	9.272	.0186	41.2
41.3	.260525	6.61734	.127957	.0054861	38.4027	.00043088	3.01563	12.6235	.1105	12.734	9.920	5.9195	15.8395	.020674	.012421	.033095	9.363	.0188	41.3
41.4	.261540	6.64312	.128456	.0055078	38.5546	.00043248	3.02684	12.6260	.1110	12.739	9.944	5.9430	15.8870	.020722	.012468	.033190	9.454	.0190	41.4
41.5	0.262555	6.66890	0.128955	0.0055295	38.7065	0.0004340	3.03805	12.6285	0.1115	12.740	9.968	5.9665	15.9345	0.020770	0.012515	0.033285	9.545	0.0192	41.5
41.6	.263570	6.69468	.129454	.0055512	38.8584	.00043564	3.04926	12.6310	.1120	12.743	9.992	5.9900	15.9820	.020818	.012562	.033380	9.636	.0194	41.6
41.7	.264585	6.72046	.129953	.0055729	39.0103	.00043728	3.06047	12.6335	.1125	12.746	10.016	6.0135	16.0295	.020866	.012609	.033475	9.727	.0196	41.7
41.8	.265600	6.74624	.130452	.0055946	39.1622	.00043888	3.07168	12.6360	.1130	12.749	10.040	6.0370	16.0770	.020914	.012656	.033570	9.818	.0198	41.8
41.9	.266615	6.77202	.130951	.0056163	39.3141	.00044044	3.08289	12.6385	.1135	12.752	10.064	6.0605	16.1245	.020962	.012703	.033665	9.909	.0200	41.9
42.0	0.26763	6.7978	0.13145	0.005638	39.466	0.000442	3.0941	12.641	0.114	12.755	10.088	6.084	16.172	0.02101	0.012750	0.03376	10.00	0.0202	42.0
42.1	.26868	6.82447	.131965	.0056602	39.6214	.00044363	3.1055	12.6435	.1143	12.758	10.1121	6.1084	16.2205	.021058	.012798	.033856	10.11	.0204	42.1
42.2	.26973	6.85114	.132480	.0056824	39.7768	.00044526	3.1169	12.6460	.1150	12.761	10.1362	6.1328	16.2690	.021406	.012846	.033952	10.22	.0206	42.2
42.3	.27078	6.87781	.132995	.0057046	39.9322	.00044689	3.1283	12.6485	.1155	12.764	10.1603	6.1572	16.3175	.021154	.012894	.034048	10.33	.0208	42.3
42.4	.27183	6.90448	.133510	.0057268	40.0876	.00044852	3.1397	12.6510	.1160	12.767	10.1844	6.1816	16.3660	.021202	.012942	.034144	10.44	.0210	42.4
42.5	0.27288	6.93115	0.134025	0.0057490	40.2430	0.00045015	3.1511	12.6535	0.1165	12.770	10.2085	6.2060	16.4145	0.021250	0.012990	0.034240	10.55	0.0212	42.5
42.6	.27393	6.95782	.134540	.0057717	40.3984	.00045178	3.1625	12.6560	.1170	12.773	10.2326	6.2304	16.4630	.021298	.013038	.034336	10.66	.0214	42.6
42.7	.27498	6.98449	.135055	.0057934	40.5538	.00045341	3.1739	12.6585	.1175	12.776	10.2567	6.2548	16.5115	.021346	.013086	.034432	10.77	.0216	42.7
42.8	.27603	7.01116	.135570	.0058156	40.7092	.00045504	3.1853	12.610	.1180	12.779	10.2808	6.2792	16.5600	.021394	.013134	.034528	10.88	.0218	42.8
42.9	.27708	7.03783	.136085	.0058378	40.8646	.00045667	3.1967	12.6635	.1185	12.782	10.3049	6.3036	16.6085	.021442	.013182	.034624	10.99	.0220	42.9
43.0	0.27813	7.0645	0.13660	0.0058860	41.020	0.0004583	3.2081	12.666	0.119	12.785	10.329	6.328	16.657	0.02149	0.01323	0.03472	11.1	0.0222	43.0
43.1	.279216	7.09208	.137134	.0058831	41.1817	.00046000	3.2200	12.6685	.1195	12.788	10.3530	6.3532	16.7062	.021538	.01328	.034818	11.2	.0224	43.1
43.2	.280302	7.11966	.137668	.0059062	41.3434	.00046617	3.2319	12.6710	.1200	12.791	10.3770	6.3784	16.7554	.021586	.01333	.034916	11.3	.0226	43.2
43.3	.281388	7.14724	.138202	.0059293	41.5051	.00046634	3.2438	12.6735	.1205	12.794	10.4010	6.4036	16.8046	.021634	.01338	.035014	11.4	.0228	43.3
43.4	.282474	7.17482	.138736	.0059524	41.6668	.00046651	3.2557	12.6760	.1210	12.797	10.4250	6.4288	16.8538	.021682	.01343	.035112	11.5	.0230	43.4
43.5	0.283560	7.20240	0.139270	0.0059755	41.8285	0.0004668	3.2676	12.6785	0.1215	12.800	10.4490	6.4540	16.9030	0.021730	0.01348	0.035210	11.6	0.0232	43.5
43.6	.284646	7.22998	.139804	.0059986	41.9902	.00046685	3.2795	12.6810	.1220	12.803	10.4730	6.4792	16.9522	.021778	.01353	.035308	11.7	.0234	43.6
43.7	.285732	7.25756	.140338	.0060217	42.1519	.00047072	3.2914	12.6835	.1225	12.806	10.4970	6.5044	17.0014	.021826	.01358	.035406	11.8	.0236	43.7
43.8	.286818	7.28514	.140872	.0060448	42.3136	.00047119	3.3033	12.6860	.1230	12.809	10.5210	6.5296	17.0506	.021874	.01363	.035504	11.9	.0238	43.8
43.9	.287904	7.31272	.141406	.0060679	42.4753	.00047136	3.3152	12.6885	.1235	12.812	10.5450	6.5548	17.0998	.021922	.01368	.035602	12.0	.0240	43.9
44.0	0.28899	7.3403	0.14194	0.006091	42.637	0.0004753	3.3271	12.691	0.124	12.815	10.569	6.580	17.149	0.021970	0.01373	0.03570	12.1	0.0242	44.0
44.1	.290114	7.36885	.142492	.006115	42.805	.00047705	3.33935	12.6936	.1245	12.8181	10.5930	6.6061	17.1991	.022018	.013782	.03580	12.2	.0244	44.1
44.2	.291238	7.39740	.143044	.006139	42.973	.00047880	3.35160	12.6962	.1250	12.8212	10.6170	6.6322	17.2492	.022066	.013834	.03590	12.3	.0246	44.2
44.3	.292362	7.42595	.143596	.006163	43.141	.00048055	3.36385	12.6988	.1255	12.8243	10.6410	6.6583	17.2993	.022114	.013886	.03600	12.4	.0248	44.3
44.4	.293486	7.45450	.144148	.006187	43.309	.00048230	3.37610	12.7014	.1260	12.8274	10.6650	6.6844	17.3494	.022162	.013938	.03610	12.5	.0250	44.4
44.5	0.294610	7.48305	0.144700	0.006211	43.477	0.00048405	3.38835	12.7040	0.1265	12.8305	10.6890	6.7105	17.3995	0.022210	0.013990	0.0362	12.6	0.0252	44.5
44.6	.295734	7.51160	.145252	.006235	43.645	.00048580	3.40060	12.7066	.1270	12.8336	10.7130	6.7366	17.4496	.022258	.014042	.03630	12.7	.0254	44.6
44.7	.296858	7.54015	.145804	.006259	43.813	.00048755	3.41285	12.7092	.1275	12.8367	10.7370	6.7627	17.4997	.022306	.014094	.03640	12.8	.0256	44.7
44.8	.297982	7.56870	.146356	.006283	43.981	.00048930	3.42510	12.7118	.1280	12.8398	10.7610	6.7888	17.5498	.022354	.014146	.03650	12.9	.0258	44.8
44.9	.299108	7.59725	.146908	.006307	44.149	.00049105	3.43735	12.7144	.1285	12.8425	10.7850	6.8149	17.5999	.022402	.014198	.03660	13.0	.0260	44.9

45.0	0.30023	7.6258	0.14746	0.006331	44.317	0.0004928	3.4496	12.717	0.129	12.846	10.809	6.841	17.650	0.022745	0.014725	0.0367	13.1	0.0262	45.0
45.1	.301392	7.65532	.148031	.0063557	44.4899	.00049461	3.46227	12.7195	.1295	12.849	10.8330	6.8681	17.7011	.022498	.014303	.036801	13.2	.0264	45.1
45.2	.302554	7.68484	.148602	.0063814	44.6629	.00049642	3.47494	12.7220	.1300	12.852	10.8570	6.8952	17.7522	.022546	.014356	.036902	13.3	.0266	45.2
45.3	.303716	7.71436	.149173	.0064051	44.8357	.00049823	3.48761	12.7245	.1305	12.855	10.881	6.9223	17.8033	.022594	.014409	.037003	13.4	.0268	45.3
45.4	.304878	7.74388	.149744	.0064298	45.0086	.00050004	3.50028	12.7270	.1310	12.858	10.905	6.9494	17.8544	.022642	.014462	.037104	13.5	.0270	45.4
45.5	0.306040	7.77440	0.150315	0.0064545	45.1815	0.00050185	3.51295	12.7295	0.1315	12.861	10.929	6.9765	17.9055	0.022690	0.014515	0.037205	13.6	0.0272	45.5
45.6	.307202	7.80292	.150886	.0064792	45.3544	.00050366	3.52562	12.7320	.1320	12.864	10.9530	7.0036	17.9566	.022738	.014868	.037306	13.7	.0274	45.6
45.7	.308364	7.83244	.151457	.0065039	45.5273	.00050547	3.53829	12.7345	.1325	12.867	10.979	7.0307	18.0077	.022786	.014621	.037407	13.8	.0276	45.7
45.8	.309526	7.86196	.152028	.0065286	45.7002	.00050728	3.55096	12.7370	.1330	12.870	11.001	7.0578	18.0588	.022834	.014674	.037508	13.9	.0278	45.8
45.9	.310688	7.89148	.152599	.0065533	45.8731	.00050909	3.56363	12.7395	.1335	12.873	11.025	7.0849	18.1099	.022882	.014727	.037609	14.0	.0280	45.9
46.0	0.31185	7.9210	0.15317	0.006578	46.046	0.0005109	3.5763	12.742	0.134	12.876	11.049	7.112	18.161	0.02293	0.01478	0.03771	14.1	0.0282	46.0
46.1	.313051	7.9515	.15376	.0066037	46.2259	.00051277	3.58939	12.7445	.1346	12.8791	11.073	7.1399	18.2129	.022977	.014836	.037818	14.2	.0284	46.1
46.2	.314252	7.9820	.15435	.0066294	46.4058	.00051464	3.60248	12.7470	.1352	12.8822	11.097	7.1678	18.2648	.023024	.014892	.037916	14.3	.0286	46.2
46.3	.315453	8.0125	.15494	.0066551	46.5857	.00051651	3.61557	12.7495	.1358	12.8853	11.121	7.1959	18.3167	.023071	.014948	.038019	14.4	.0288	46.3
46.4	.316654	8.0430	.15553	.0066808	46.7656	.00051838	3.62866	12.7520	.1364	12.8884	11.145	7.2236	18.3686	.023118	.015004	.038122	14.5	.0290	46.4
46.5	0.317855	8.0735	0.15612	0.0067065	46.9455	0.00052025	3.64175	12.7545	0.1370	12.8915	11.169	7.2515	18.4205	0.023165	0.015060	0.038225	14.6	0.0292	46.5
46.6	.319056	8.1040	.15671	.0067322	47.1254	.00052212	3.65484	12.7570	.1376	12.8946	11.193	7.2794	18.4724	.023212	.015116	.038328	14.7	.0294	46.6
46.7	.320257	8.1345	.15730	.0067579	47.3053	.00052399	3.66793	12.7595	.1382	12.8977	11.217	7.3073	18.5243	.023259	.015172	.038431	14.8	.0296	46.7
46.8	.321458	8.1650	.15789	.0067836	47.4852	.00052586	3.68102	12.7620	.1388	12.9008	11.241	7.3352	18.5762	.023306	.015228	.038534	14.9	.0298	46.8
46.9	.322659	8.1955	.15848	.0068093	47.6651	.00052773	3.69411	12.7645	.1394	12.9039	11.265	7.3631	18.6281	.023353	.015284	.038637	15.0	.0300	46.9
47.0	0.32386	8.2260	0.15907	0.006835	47.845	0.0005296	3.7072	12.767	0.140	12.907	11.289	7.391	18.680	0.02340	0.01534	0.03874	15.1	0.0302	47.0
47.1	.325103	8.25758	.15968	.0068615	48.0305	.00053152	3.72064	12.7685	.1406	12.9101	11.3131	7.420	18.7331	.023447	.015397	.038844	15.201	.03039	47.1
47.2	.326346	8.28916	.16029	.0068880	48.2160	.00053344	3.73408	12.7700	.1412	12.9132	11.3372	7.449	18.7862	.023494	.015454	.038948	15.302	.03058	47.2
47.3	.327589	8.32074	.16090	.0069145	48.4015	.00053536	3.74752	12.7715	.1418	12.9163	11.3613	7.478	18.8393	.023541	.015511	.039052	15.403	.03079	47.3
47.4	.328832	8.35232	.16151	.0069410	48.5870	.00053728	3.76096	12.7730	.1424	12.9194	11.3854	7.507	18.8924	.023588	.015568	.039156	15.504	.03096	47.4
47.5	0.330075	8.38390	0.16212	0.0069675	48.7725	0.00053920	3.77440	12.7745	0.1430	12.9225	11.4095	7.536	18.9455	0.023635	0.015625	0.039260	15.605	0.03115	47.5
47.6	.331318	8.41548	.16273	.0069940	49.9580	.00054112	3.78784	12.7760	.1436	12.9256	11.4336	7.565	18.9986	.023682	.015682	.039364	15.706	.03134	47.6
47.7	.332561	8.44706	.16334	.0070205	49.1435	.00054304	3.80128	12.7775	.1442	12.9287	11.4577	7.594	19.0517	.023729	.015739	.039468	15.807	.03153	47.7
47.8	.333804	8.47864	.16395	.0070470	49.3290	.00054496	3.81472	12.7790	.1448	12.9318	11.4818	7.623	19.1048	.023776	.015796	.039572	15.908	.03172	47.8
47.9	.335047	8.51022	.16456	.0070735	49.5145	.00054688	3.82816	12.7805	.1454	12.9349	11.5059	7.652	19.1579	.023823	.015853	.039676	16.009	.03191	47.9
48.0	0.33629	8.5418	0.16517	0.007100	49.70	0.0005488	3.8416	12.792	0.146	12.938	11.530	7.681	19.211	0.02387	0.01591	0.03978	16.11	0.0321	48.0
48.1	.337574	8.5742	.165801	.0071274	49.8918	.00055078	3.85546	12.7946	.1465	12.9411	11.554	7.711	19.265	.023917	.015969	.039886	16.21	.0323	48.1
48.2	.338858	8.6066	.166432	.0071548	50.0836	.00055276	3.86932	12.7972	.1470	12.9442	11.578	7.741	19.319	.023964	.016028	.039992	16.31	.0325	48.2
48.3	.340142	8.6396	.167063	.0071822	50.2754	.00055474	3.88318	12.7998	.1475	12.9473	11.602	7.771	19.373	.024011	.016087	.040098	16.41	.0327	48.3
48.4	.341426	8.6714	.167694	.0072096	50.4672	.00055672	3.89704	12.8024	.1480	12.9504	11.626	7.801	19.427	.024058	.016146	.040204	16.51	.0329	48.4
48.5	0.342710	8.7038	0.168325	0.0072370	50.6590	0.00055870	3.91090	12.8050	0.1485	12.9535	11.650	7.831	19.481	0.024105	0.016205	0.040310	16.61	0.0331	48.5
48.6	.343994	8.7362	.168956	.0072644	50.8508	.00056068	3.92476	12.8076	.1490	12.9566	11.674	7.861	19.535	.024152	.016264	.040416	16.71	.0333	48.6
48.7	.345278	8.7686	.169587	.0072918	51.0426	.00056266	3.93862	12.8102	.1495	12.9597	11.698	7.891	19.589	.024199	.016323	.040522	16.81	.0335	48.7
48.8	.346562	8.8010	.170218	.0073192	51.2344	.00056464	3.95248	12.8128	.1500	12.9628	11.722	7.921	19.643	.024246	.016382	.040628	16.91	.0337	48.8
48.9	.347846	8.8334	.170849	.0073466	51.4262	.00056662	3.96634	12.8154	.1505	12.9659	11.746	7.951	19.697	.024293	.016441	.040734	17.01	.0339	48.9
49.0	0.34913	8.8658	0.17148	0.007374	51.618	0.0005686	3.9802	12.818	0.151	12.969	11.770	7.981	19.751	0.02434	0.01650	0.04084	17.11	0.0341	49.0
49.1	.350457	8.89972	.172131	.0074024	51.8168	.00057064	3.99448	12.8205	.1517	12.9722	11.794	8.012	19.806	.024387	.016561	.040948	17.21	.0343	49.1
49.2	.351784	8.93364	.172782	.0074308	52.0156	.00057268	4.00876	12.8230	.1524	12.9754	11.818	8.043	19.861	.024434	.016622	.041056	17.31	.0345	49.2
49.3	.353111	8.96756	.173433	.0074592	52.2144	.00057472	4.02304	12.8255	.1531	12.9786	11.842	8.074	19.916	.024481	.016683	.041164	17.41	.0347	49.3
49.4	.354438	9.00148	.174084	.0074876	52.4132	.00057676	4.03732	12.8280	.1538	12.9818	11.866	8.105	19.971	.024528	.016744	.041272	17.51	.0349	49.4

49.5	0.355765	9.03540	0.174735	0.0075160	52.6120	0.00057880	4.05160	12.8305	0.1545	12.9850	11.890	8.136	20.026	0.024575	0.016806	0.041380	17.61	0.0351	49.5
49.6	.357092	9.06932	.175386	.0075444	52.8108	.00058084	4.06588	12.8330	.1552	12.9882	11.914	8.167	20.081	.024622	.016866	.041488	17.71	.0353	49.6
49.7	.358419	9.10324	.176037	.0075728	53.0096	.00058288	4.08016	12.8355	.1559	12.9914	11.938	8.198	20.136	.024669	.016927	.041596	17.81	.0355	49.7
49.8	.359746	9.13716	.176688	.0076012	53.2084	.00058492	4.09444	12.8380	.1566	12.9946	11.962	8.229	20.191	.024716	.016988	.041704	17.91	.0357	49.8
49.9	.361073	9.17108	.177339	.0076296	53.4072	.00058696	4.10872	12.8405	.1573	12.9978	11.986	8.260	20.246	.024763	.017049	.041817	18.01	.0359	49.9
50.0	0.36240	9.20508	0.17799	0.007658	53.606	0.0005890	4.1230	12.843	0.158	13.001	12.01	8.291	20.301	0.02481	0.01711	0.04192	18.11	0.0361	50.0
50.1	.363771	9.23982	.178664	.0076874	53.8118	.00059112	4.13784	12.8455	.1586	13.0041	12.034	8.3231	20.3571	.024857	.017173	.04203	18.21	.0363	50.1
50.2	.365142	9.27464	.179338	.0077168	54.0176	.00059324	4.15268	12.8480	.1592	13.0072	12.058	8.3552	20.4132	.024904	.017236	.04214	18.31	.0365	50.2
50.3	.366513	9.30946	.180012	.0077467	54.2234	.00059536	4.16752	12.8505	.1598	13.0103	12.082	8.3873	20.4693	.024951	.017299	.04225	18.41	.0367	50.3
50.4	.367884	9.34428	.180686	.0077756	54.4292	.00059748	4.18236	12.8530	.1604	13.0134	12.106	8.4194	20.5254	.024998	.017362	.04236	18.51	.0369	50.4
50.5	0.369255	9.37910	0.181360	0.0078050	54.6350	0.00059960	4.19720	12.8555	0.1610	13.0165	12.130	8.4515	20.5815	0.025045	0.017425	0.04247	18.61	0.0371	50.5
50.6	.370626	9.41392	.182034	.0078344	54.8408	.00060172	4.21204	12.8580	.1616	13.0196	12.154	8.4836	20.6376	.025092	.017488	.04258	18.71	.0373	50.6
50.7	.371997	9.44874	.182708	.0078638	55.0466	.00060384	4.22688	12.8605	.1622	13.0227	12.178	8.5157	20.6937	.025139	.017551	.04269	18.81	.0375	50.7
50.8	.373368	9.48356	.183382	.0078932	55.2524	.00060596	4.24172	12.8630	.1628	13.0258	12.202	8.5478	20.7498	.025186	.017614	.04280	18.91	.0377	50.8
50.9	.374739	9.51838	.184056	.0079226	55.4582	.00060808	4.25656	12.8655	.1634	13.0289	12.226	8.5799	20.8059	.025233	.017677	.04291	19.01	.0379	50.9
51.0	0.37611	9.5532	0.18473	0.007952	55.664	0.0006102	4.2714	12.868	0.164	13.032	12.25	8.612	20.862	0.02528	0.01774	0.04302	19.11	0.0381	51.0
51.1	.377527	9.58519	.185426	.0079824	55.8768	.00061238	4.28666	12.8706	.1646	13.0352	12.2741	8.6453	20.9194	.025327	.017805	.043132	19.21	.03829	51.1
51.2	.378944	9.62518	.186122	.0080128	56.0896	.00061456	4.30192	12.8732	.1652	13.0384	12.2982	8.6786	20.9768	.025374	.017870	.043244	19.31	.03848	51.2
51.3	.380361	9.66117	.186818	.0080432	56.3024	.00061674	4.31718	12.8758	.1658	13.0416	12.3223	8.7119	21.0342	.025421	.017935	.043356	19.41	.03867	51.3
51.4	.381778	9.69716	.187514	.0080736	56.5152	.00061892	4.33244	12.8784	.1664	13.0448	12.3464	8.7452	21.0916	.025468	.018000	.043468	19.51	.03886	51.4
51.5	0.383195	9.73315	0.188210	0.0081040	56.7280	0.00062110	4.34770	12.8810	0.1670	13.0480	12.3705	8.7785	21.1490	0.025515	0.018065	0.043580	19.61	0.03905	51.5
51.6	.384612	9.76914	.188906	.0081344	56.9408	.00062328	4.36296	12.8836	.1676	13.0512	12.3946	8.8118	21.2064	.025562	.018130	.043692	19.71	.03924	51.6
51.7	.386029	9.80513	.189602	.0081648	57.1536	.00062546	4.37822	12.8862	.1682	13.0544	12.4187	8.8451	21.2638	.025609	.018195	.043804	19.81	.03943	51.7
51.8	.387446	9.84112	.190298	.0081952	57.3664	.00062764	4.39348	12.8888	.1688	13.0576	12.4428	8.8784	21.3212	.025656	.018260	.044916	19.91	.03962	51.8
51.9	.388863	9.87711	.190994	.0082256	57.5792	.00062982	4.40874	12.8914	.1694	13.0608	12.4669	8.9117	21.3786	.025703	.018325	.044028	20.01	.03981	51.9
52.0	0.39028	9.9131	0.19169	0.008256	57.792	0.0006320	4.4240	12.894	0.170	13.064	12.491	8.945	21.436	0.02575	0.01839	0.04414	20.11	0.0400	52.0
52.1	.391744	9.95029	.192469	.0082873	58.0111	.00063423	4.43961	12.8965	.1708	13.0673	12.515	8.9794	21.4944	.025797	.018457	.044254	20.211	.0402	52.1
52.2	.393208	9.98748	.193128	.0083182	58.2302	.00063646	4.45522	12.8990	.1716	13.0706	12.539	9.0138	21.5528	.025844	.018524	.044368	20.312	.0404	52.2
52.3	.394672	10.02467	.193847	.0083499	58.4493	.00063869	4.47083	12.9015	.1724	13.0739	12.563	9.0482	21.6112	.025891	.018591	.044482	20.413	.0406	52.3
52.4	.396136	10.06186	.194566	.0083817	58.6684	.00064092	4.48644	12.9040	.1732	13.0772	12.587	9.0826	21.6696	.025938	.018658	.044596	20.514	.0408	52.4
52.5	0.397600	10.09905	0.195285	0.0084125	58.8875	0.00064315	4.50205	12.9065	0.1740	13.0805	12.611	9.1170	21.7280	0.025985	0.018725	0.044710	20.615	0.0410	52.5
52.6	.399064	10.13624	.196004	.0084438	59.1066	.00064538	4.51766	12.9090	.1748	13.0838	12.635	9.1514	21.7864	.026032	.018792	.044824	20.716	.0412	52.6
52.7	.400528	10.17343	.196723	.0084751	59.3257	.00064761	4.53327	12.9115	.1756	13.0871	12.659	9.1858	21.8448	.026079	.018859	.044938	20.817	.0414	52.7
52.8	.401992	10.20862	.197442	.0085064	59.5448	.00064984	4.54888	12.9140	.1764	13.0904	12.683	9.2202	21.9032	.026126	.018926	.045052	20.918	.0416	52.8
52.9	.403456	10.24781	.198161	.0085377	59.7639	.00065207	4.56449	12.9165	.1762	13.0937	12.707	9.2546	21.9616	.026173	.018993	.045166	21.019	.0418	52.9
53.0	0.40492	10.2850	0.19888	0.008569	59.983	0.0006543	4.5801	12.919	0.178	13.097	12.731	9.289	22.020	0.02622	0.01906	0.04528	21.12	0.0420	53.0
53.1	.406432	10.32334	.199622	.0086015	60.2105	.00065661	4.59627	12.9215	.1787	13.1002	12.755	9.3245	22.0795	.026267	.01913	.045397	21.22	.04219	53.1
53.2	.407944	10.3618	.200364	.0086340	60.4380	.00065892	4.61244	12.9240	.1794	13.1034	12.779	9.3600	22.1390	.026314	.01920	.045514	21.32	.04238	53.2
53.3	.409456	10.40002	.201106	.0086665	60.6655	.00066123	4.62861	12.9265	.1801	13.1066	12.803	9.3955	22.1985	.026361	.01927	.045631	21.42	.04257	53.3
53.4	.410967	10.43886	.201848	.0086990	60.8930	.00066354	4.64478	12.9290	.1808	13.1098	12.827	9.4310	22.2580	.026408	.01934	.045748	21.52	.04276	53.4
53.5	0.412478	10.4770	0.202590	0.0087315	61.1205	0.00066585	4.66095	12.9315	0.1815	13.1130	12.851	9.4665	22.3175	0.026455	0.01941	0.045865	21.62	0.04295	53.5
53.6	.413990	10.5154	.203332	.0087640	61.3480	.00066816	4.67712	12.9340	.1822	13.1162	12.875	9.5020	22.3770	.026502	.01948	.045982	21.72	.04314	53.6
53.7	.415502	10.5538	.204074	.0087965	61.5755	.00067047	4.69329	12.9365	.1829	13.1194	12.899	9.5375	22.4365	.026549	.01955	.046099	21.82	.04333	53.7
53.8	.417014	10.5922	.204816	.0088290	61.8030	.00067278	4.70946	12.9390	.1836	13.1226	12.923	9.5730	22.4960	.026596	.01962	.046216	21.92	.04352	53.8
53.9	.418526	10.6366	.205558	.0088615	62.0305	.00067509	4.72563	12.9415	.1843	13.1258	12.947	9.6085	22.5555	.026643	.01969	.046333	22.02	.04371	53.9

54.0	0.42004	10.6690	0.20630	0.008894	62.258	0.0006774	4.7418	12.944	0.185	13.129	12.971	9.644	22.615	0.02669	0.019376	0.04645	22.12	0.0439	54.0
54.1	.421601	10.70855	.207067	.0089275	62.4925	.00067978	4.75846	12.9466	.1857	13.1323	12.995	9.6805	22.6755	.026737	.019831	.046568	22.22	.0441	54.1
54.2	.423162	10.74830	.207834	.0089610	62.7270	.00068216	4.77512	12.9492	.1864	13.1356	13.019	9.7170	22.7360	.026784	.019902	.046686	22.32	.0443	54.2
54.3	.424723	10.78795	.208601	.0089945	62.9615	.00068454	4.79178	12.9518	.1871	13.1389	13.043	9.7535	22.7965	.026831	.019973	.046804	22.42	.0445	54.3
54.4	.426284	10.82760	.209368	.0090280	63.1960	.00068692	4.80844	12.9544	.1878	13.1422	13.067	9.7900	22.8570	.026878	.020044	.046922	22.52	.0447	54.4
54.5	0.427845	10.86725	0.210135	0.0090615	63.4305	0.00068930	4.82510	12.9570	0.1885	13.1455	13.091	9.8265	22.9175	0.026925	0.020115	0.047040	22.62	0.0449	54.5
54.6	.429406	10.90690	.210902	.0090950	63.6630	.00069168	4.84176	12.9596	.1892	13.1488	13.115	9.8630	22.9780	.026972	.020186	.047158	22.72	.0451	54.6
54.7	.430967	10.94654	.211669	.0091285	63.8995	.00069406	4.85842	12.9622	.1899	13.1521	13.139	9.8995	23.0385	.027019	.020257	.047276	22.82	.0453	54.7
54.8	.432528	10.98619	.212436	.0091620	64.1340	.00069644	4.87508	12.9648	.1906	13.1554	13.163	9.9360	23.0990	.027066	.020328	.047394	22.92	.0455	54.8
54.9	.434089	11.02584	.213203	.0091955	64.3685	.00069882	4.89174	12.9674	.1913	13.1587	13.187	9.9725	23.1595	.027113	.020399	.047512	23.02	.0457	54.9
55.0	0.43565	11.0655	0.21397	0.009229	64.603	0.0007012	4.9084	12.970	0.192	13.162	13.211	10.009	23.22	0.02716	0.02047	0.04763	23.12	0.0459	55.0
55.1	.437261	11.10647	.214761	.0092636	64.8452	.00070365	4.92555	12.9725	.1928	13.1653	13.2361	10.0469	23.282	.027206	.020544	.04775	23.22	.04609	55.1
55.2	.438827	11.14734	.215552	.0092982	65.0874	.00070610	4.94270	12.9750	.1936	13.1686	13.2592	10.0848	23.344	.027252	.020618	.04787	23.32	.04628	55.2
55.3	.440483	11.18826	.216343	.0093328	65.3296	.00070855	4.95985	12.9775	.1944	13.1719	13.2833	10.1227	23.406	.027298	.020692	.04799	23.42	.04647	55.3
55.4	.442054	11.22918	.217134	.0093674	65.5718	.00071100	4.97700	12.9800	.1952	13.1752	13.3074	10.1606	23.468	.027344	.020766	.04811	23.52	.04666	55.4
55.5	0.443705	11.27010	0.218925	0.0094020	65.8140	0.00071345	4.99415	12.9825	0.1960	13.1785	13.3315	10.1985	23.530	0.027390	0.020840	0.04823	23.62	0.04685	55.5
55.6	.445316	11.31102	.218716	.0094366	66.0582	.00071590	5.01130	12.9850	.1968	13.1818	13.3556	10.2364	23.592	.027436	.020914	.04835	23.72	.04704	55.6
55.7	.446927	11.35194	.219507	.0094712	66.2984	.00071835	5.02845	12.9875	.1976	13.1851	13.3797	10.2743	23.654	.027482	.020988	.04847	23.82	.04723	55.7
55.8	.448538	11.39286	.220298	.0095058	66.5406	.00072080	5.04560	12.9900	.1984	13.1884	13.4038	10.3122	23.716	.027528	.021062	.04859	23.92	.04742	55.8
55.9	.450149	11.43378	.221089	.0095404	66.7828	.00072325	5.06275	12.9925	.1992	13.1917	13.4279	10.3501	23.778	.027574	.021136	.04871	24.02	.04761	55.9
56.0	0.45176	11.4747	0.22188	0.009575	67.025	0.0007257	5.0799	12.995	0.200	13.193	13.452	10.388	23.84	0.02762	0.02121	0.04883	24.12	0.0478	56.0
56.1	.453424	11.51697	.222698	.0096109	67.2763	.00072823	5.09761	12.9975	.2008	13.1983	13.476	10.428	23.904	.027667	.021286	.048953	24.22	.04799	56.1
56.2	.455088	11.55924	.223516	.0096468	67.5276	.00073076	5.11532	13.0000	.2016	13.2016	13.500	10.468	23.968	.027714	.021362	.049076	24.32	.04818	56.2
56.3	.456752	11.60151	.224334	.0096827	67.7789	.00073329	5.13303	13.0025	.2024	13.2049	13.524	10.508	24.032	.027761	.021438	.049199	24.42	.04837	56.3
56.4	.458416	11.64378	.225152	.0097186	68.0302	.00073582	5.15074	13.0050	.2032	13.2082	13.548	10.548	24.096	.027808	.021514	.049322	24.52	.04856	56.4
56.5	0.460080	11.68605	0.226975	0.0097545	68.2815	0.0007383	5.16845	13.0075	0.2040	13.2115	13.572	10.588	24.160	0.027855	0.021590	0.049445	24.62	0.04875	56.5
56.6	.461744	11.72832	.227788	.0097904	68.5328	.00074088	5.18616	13.0100	.2048	13.2148	13.596	10.628	24.224	.027902	.021666	.049568	24.72	.04894	56.6
56.7	.463408	11.77059	.227606	.0098263	68.7841	.00074341	5.20387	13.0125	.2056	13.2181	13.620	10.668	24.288	.027949	.021742	.049691	24.82	.04913	56.7
56.8	.465072	11.81286	.228424	.0098627	69.0354	.00074594	5.22158	13.0150	.2064	13.2214	13.644	10.708	24.352	.027996	.021818	.049814	24.92	.04932	56.8
56.9	.466736	11.85513	.229242	.0098981	69.2867	.00074847	5.23929	13.0175	.2072	13.2247	13.668	10.748	24.416	.028043	.021894	.049937	25.02	.04951	56.9
57.0	0.46840	11.8974	0.23006	0.009934	69.538	0.0007510	5.2570	13.020	0.208	13.228	13.692	10.788	24.48	0.02809	0.02197	0.05006	25.12	0.0497	57.0
57.1	.470118	11.94092	.230903	.0099706	69.7942	.00075357	5.27499	13.0225	.2088	13.2313	13.716	10.828	24.544	.028136	.022049	.050185	25.22	.0499	57.1
57.2	.471836	11.98444	.231746	.0100072	70.0504	.00075614	5.29298	13.0250	.2096	13.2346	13.740	10.868	24.608	.028182	.022128	.050310	25.32	.0501	57.2
57.3	.473554	12.02796	.232589	.0100438	70.3066	.00075871	5.31097	13.0275	.2104	13.2379	13.764	10.908	24.672	.028228	.022207	.050435	25.42	.0503	57.3
57.4	.475272	12.07148	.233432	.0100804	70.5628	.00076128	5.32896	13.0300	.2112	13.2412	13.788	10.948	24.736	.028274	.022286	.050560	25.52	.0505	57.4
57.5	0.476990	12.11500	0.234275	0.0101170	70.8190	0.0007638	5.34695	13.0325	0.2120	13.2478	13.812	10.988	24.800	0.028320	0.022365	0.050685	25.62	0.0507	57.5
57.6	.478708	12.15852	.235118	.0101536	71.0752	.00076642	5.36494	13.0350	.2128	13.2478	13.836	11.028	24.864	.028366	.022444	.050810	25.72	.0509	57.6
57.7	.480426	12.20204	.235961	.0101902	71.3314	.00076899	5.38293	13.0375	.2136	13.2511	13.860	11.068	24.928	.028412	.022523	.050935	25.82	.0511	57.7
57.8	.482144	12.24556	.236804	.0102268	71.5876	.00077156	5.40092	13.0400	.2144	13.2544	13.884	11.108	24.992	.028458	.022602	.051060	25.92	.0513	57.8
57.9	.483862	12.28908	.237647	.0102634	71.8438	.00077413	5.41891	13.0425	.2152	13.2577	13.908	11.148	25.056	.028504	.022681	.051185	26.02	.0515	57.9
58.0	0.48558	12.3326	0.23849	0.010300	72.100	0.0007767	5.4369	13.045	0.216	13.261	13.932	11.188	25.12	0.02855	0.02276	0.05131	26.12	0.0517	58.0
58.1	.487352	12.37772	.239361	.0103390	72.373	.00077938	5.45566	13.0476	.2168	13.2644	13.956	11.230	25.186	.028597	.022841	.051438	26.22	.05189	58.1
58.2	.489124	12.42284	.240232	.0103780	72.646	.00078206	5.47442	13.0502	.2176	13.2678	13.980	11.272	25.252	.028644	.022922	.051566	26.32	.05208	58.2
58.3	.490896	12.46796	.241103	.0104170	72.919	.00078474	5.49318	13.0528	.2184	13.2712	14.004	11.314	25.318	.028691	.023003	.051694	26.42	.05227	58.3
58.4	.492668	12.51308	.241974	.0104560	73.192	.00078742	5.51194	13.0554	.2192	13.2746	14.028	11.356	25.384	.028738	.023084	.051822	26.52	.05246	58.4

58.5	0.494440	12.55820	0.242845	0.010495	73.465	0.00079010	5.53070	13.0580	0.2200	13.2780	14.052	11.398	25.450	0.028785	0.023165	0.051950	26.62	0.05265	58.5
58.6	.496212	12.60332	.243716	.010534	73.738	.00079278	5.54946	13.0606	.2208	13.2814	14.076	11.440	25.516	.028832	.023246	.052078	26.72	.05284	58.6
58.7	.497984	12.64844	.244587	.010573	74.011	.00079546	5.56822	13.0632	.2216	13.2848	14.100	11.482	25.582	.028879	.023327	.052206	26.82	.05303	58.7
58.8	.499756	12.69356	.245458	.010612	74.284	.00079814	5.58698	13.0658	.2224	13.2882	14.124	11.524	25.648	.028926	.023408	.052334	26.92	.05322	58.8
58.9	.501528	12.73868	.246329	.010651	74.557	.00080082	5.60574	13.0684	.2232	13.2916	14.148	11.566	25.714	.028973	.023489	.052462	27.02	.05341	58.9
59.0	0.50330	12.7838	0.2472	0.01069	74.830	0.0008035	5.6245	13.071	0.224	13.295	14.172	11.608	25.78	0.02902	0.02357	0.05259	27.12	0.05360	59.0
59.1	.505129	12.83026	.248098	.010729	75.103	.00080628	5.64396	13.0735	.2249	13.2984	14.1961	11.6419	25.848	.029066	.023654	.05272	27.22	.05379	59.1
59.2	.506958	12.87672	.248996	.010768	75.376	.00080906	5.66342	13.0760	.2258	13.3018	14.2202	11.6758	25.916	.029112	.023738	.05285	27.32	.05398	59.2
59.3	.508787	12.92318	.249894	.010807	75.649	.00081184	5.68288	13.0785	.2267	13.3052	14.2443	11.7097	25.984	.029158	.023822	.05298	27.42	.05417	59.3
59.4	.510616	12.96964	.250792	.010846	75.922	.00081462	5.70234	13.0810	.2276	13.3086	14.2684	11.7436	26.052	.029204	.023906	.05311	27.52	.05436	59.4
59.5	0.512445	13.01610	0.251690	0.010885	76.195	0.00081740	5.72180	13.0835	0.2285	13.3120	14.2925	11.7775	26.120	0.029250	0.023990	0.05324	27.62	0.05455	59.5
59.6	.514274	13.06256	.252588	.010924	76.468	.00082018	5.74126	13.0860	.2294	13.3154	14.3166	11.8114	26.188	.029296	.024074	.05337	27.72	.05474	59.6
59.7	.516103	13.10902	.253486	.010963	76.741	.00082296	5.76072	13.0885	.2303	13.3188	14.3407	11.8453	26.256	.029342	.024158	.05350	27.82	.05493	59.7
59.8	.517932	13.15548	.254384	.011002	77.014	.00082574	5.78018	13.0910	.2312	13.3222	14.3648	11.8792	26.324	.029388	.024242	.05363	27.92	.05512	59.8
59.9	.519761	13.20194	.255282	.011041	77.287	.00082852	5.79964	13.0935	.2321	13.3256	14.3889	11.9131	26.392	.029434	.024326	.05376	28.02	.05531	59.9
60.0	0.52159	13.2484	0.25618	0.01108	77.56	0.0008313	5.8191	13.096	0.233	13.329	14.413	12.047	26.46	0.02948	0.02441	0.05389	28.12	0.05550	60.0
60.1	.523478	13.29635	.257107	.011121	77.847	.00083415	5.83905	13.0985	.2339	13.3324	14.437	12.092	26.529	.029526	.024496	.054022	28.22	.05569	60.1
60.2	.525366	13.34430	.258034	.011162	78.134	.00083700	5.85900	13.1010	.2348	13.3358	14.461	12.137	26.598	.029572	.024582	.054154	28.32	.05588	60.2
60.3	.527254	13.39225	.258961	.011203	78.421	.00083985	5.87895	13.1035	.2357	13.3392	14.485	12.182	26.667	.029618	.024668	.054286	28.42	.05607	60.3
60.4	.529142	13.44020	.259888	.011244	78.708	.00084270	5.89890	13.1060	.2366	13.3426	14.509	12.227	26.736	.029664	.024754	.054418	28.52	.05626	60.4
60.5	0.531030	13.48815	0.260815	0.011285	78.995	0.00084555	5.91885	13.1085	0.2375	13.3460	14.533	12.272	26.805	0.029710	0.024849	0.054559	28.62	0.05645	60.5
60.6	.532918	13.53610	.261742	.011326	79.282	.00084840	5.93880	13.1110	.2384	13.3494	14.557	12.317	26.874	.029756	.024926	.054682	28.72	.05664	60.6
60.7	.534806	13.58405	.262669	.011367	79.569	.00085125	5.95875	13.1135	.2393	13.3528	14.581	12.362	26.943	.029802	.025012	.054814	28.82	.05683	60.7
60.8	.536694	13.63200	.263596	.011408	79.856	.00085410	5.97870	13.1160	.2402	13.3562	14.605	12.407	27.012	.029848	.025098	.054946	28.92	.05702	60.8
60.9	.538582	13.67995	.264523	.011449	80.143	.00085695	5.99865	13.1185	.2411	13.3596	14.629	12.452	27.081	.029894	.025184	.055078	29.02	.05721	60.9
61.0	0.54047	13.7279	0.26545	0.01149	80.43	0.0008598	6.0186	13.121	0.242	13.363	14.653	12.497	27.15	0.02994	0.02527	0.05521	29.12	0.05740	61.0
61.1	.542417	13.78736	.266407	.011532	80.724	.00086271	6.03897	13.1236	.2429	13.3665	14.677	12.543	27.220	.029986	.025359	.055345	29.22	.0576	61.1
61.2	.544364	13.83682	.267364	.011574	81.018	.00086562	6.05934	13.1262	.2438	13.3700	14.701	12.589	27.290	.030032	.025448	.055480	29.32	.0578	61.2
61.3	.546311	13.88628	.268321	.011616	81.312	.00086853	6.07971	13.1288	.2447	13.3735	14.725	12.635	27.360	.030078	.025537	.055615	29.42	.0580	61.3
61.4	.548258	13.93574	.269278	.011658	81.606	.00087144	6.10008	13.1314	.2456	13.3770	14.749	12.681	27.430	.030124	.025626	.055750	29.52	.0582	61.4
61.5	0.550205	13.98520	0.270235	0.011700	81.900	0.00087435	6.12045	13.1340	0.2465	13.3805	14.773	12.727	27.500	0.030170	0.025715	0.055885	29.62	0.0584	61.5
61.6	.552152	14.03466	.271192	.011742	82.194	.00087726	6.14082	13.1366	.2474	13.3840	14.797	12.773	27.570	.030216	.025804	.056020	29.72	.0586	61.6
61.7	.554099	14.08312	.272149	.011784	82.488	.00088017	6.16119	13.1392	.2483	13.3875	14.821	12.819	27.640	.030262	.025893	.056155	29.82	.0588	61.7
61.8	.556046	14.13258	.273106	.011826	82.782	.00088308	6.18156	13.1418	.2492	13.3910	14.845	12.865	27.710	.030308	.025982	.056290	29.92	.0590	61.8
61.9	.557993	14.18204	.274063	.011868	83.076	.00088599	6.20193	13.1444	.2501	13.3945	14.869	12.911	27.780	.030354	.026071	.056425	30.02	.0592	61.9
62.0	0.55994	14.2225	0.27502	0.01191	83.37	0.0008889	6.2223	13.147	0.251	13.398	14.893	12.957	27.85	0.03040	0.02616	0.05656	30.12	0.0594	62.0
62.1	.561948	14.2735	.276006	.011954	83.678	.00089195	6.24365	13.1495	.2521	13.4015	14.9171	13.0049	27.927	.030446	.026252	.056698	30.22	.05959	62.1
62.2	.563956	14.3245	.276992	.011998	83.986	.00089500	6.26500	13.1520	.2532	13.4050	14.9417	13.0528	27.994	.030492	.026344	.056836	30.32	.05978	62.2
62.3	.565964	14.3755	.277978	.012042	84.294	.00089805	6.28635	13.1545	.2543	13.4085	14.9653	13.1007	28.066	.030538	.026436	.056974	30.42	.05997	62.3
62.4	.567972	14.4265	.278964	.012086	84.602	.00090110	6.30770	13.1570	.2554	13.4120	14.9894	13.1486	28.138	.030584	.026528	.057112	30.52	.06016	62.4
62.5	0.569980	14.4775	0.279950	0.012130	84.910	0.00090415	6.32905	13.1595	0.2565	13.4155	15.0135	13.1965	28.210	0.030630	0.026620	0.057250	30.62	0.06035	62.5
62.6	.571988	14.5285	.280936	.012174	85.218	.00090720	6.35040	13.1620	.2576	13.4190	15.0376	13.2444	28.282	.030676	.026712	.057378	30.72	.06054	62.6
62.7	.573996	14.5795	.281922	.012218	85.526	.00091025	6.37175	13.1645	.2587	13.4225	15.0617	13.2923	28.354	.030722	.026804	.057526	30.82	.06073	62.7
62.8	.576004	14.6305	.282908	.012262	85.834	.00091330	6.39310	13.1670	.2598	13.4260	15.0858	13.3402	28.426	.030768	.026896	.057664	30.92	.06092	62.8
62.9	.578007	14.6815	.283894	.012306	86.142	.00091635	6.41445	13.1695	.2609	13.4295	15.1099	13.3881	28.498	.030814	.026988	.057802	31.02	.06111	62.9

63.0	0.58002	14.7325	0.28488	0.01235	86.45	.0009194	6.4358	13.172	0.262	13.433	15.134	13.436	28.57	0.03086	0.02708	0.05794	31.12	0.0613	63.0
63.1	.582091	14.7851	.285897	.012395	86.765	.0009225	6.45750	13.1745	.2629	13.4365	15.158	13.486	28.644	.030906	.027175	.058081	31.22	.06149	63.1
63.2	.584162	14.8377	.286914	.012440	87.080	.0009256	6.4792	13.1770	.2638	13.4400	15.182	13.536	28.718	.030952	.027270	.058222	31.32	.06168	63.2
63.3	.586233	14.8903	.287931	.012485	87.395	.0009287	6.5009	13.1795	.2647	13.4435	15.206	13.586	28.792	.030998	.027365	.058363	31.42	.06187	63.3
63.4	.588304	14.9429	.288948	.012530	87.710	.0009318	6.5226	13.1820	.2656	13.4470	15230	13.636	28.866	.031044	.027460	.058504	31.52	.06206	63.4
63.5	0.590375	14.9955	0.289965	0.012575	88.025	.0009349	6.5443	13.1845	0.2665	13.4505	15.254	13.686	28.940	0.03109	0.027555	0.058645	31.62	0.06225	63.5
63.6	.592446	15.0481	.290982	.012620	88.340	.0009380	6.5660	13.1870	.2674	13.4540	15.278	13.736	29.014	.031136	.027650	.058786	31.72	.06244	63.6
63.7	.594517	15.1007	.291999	.012665	88.655	.0009411	6.5877	13.1895	.2683	13.4575	15.302	13.786	29.088	.031182	.027745	.058927	31.82	.06263	63.7
63.8	.596588	15.1533	.293016	.012710	88.970	.0009442	6.6094	13.1920	.2692	13.4610	15.326	13.836	29.162	.031228	.027840	.059068	31.92	.06282	63.8
63.9	.598659	15.2059	.294033	.012755	89.285	.0009473	6.6311	13.1945	.2701	13.4645	15.350	13.886	29.236	.031274	.027935	.059209	32.02	.06301	63.9
64.0	0.60073	15.2585	0.29505	0.01280	89.60	.0009504	6.6528	13.197	0.271	13.468	15.374	13.936	29.31	0.031320	0.28030	0.05935	32.12	0.06320	64.0
64.1	.602866	15.31276	.296099	.012846	89.922	.00095556	6.67492	13.1995	.2721	13.4716	15.398	13.987	29.385	.031365	.028128	.059493	32.219	.06339	64.1
64.2	.605002	15.36702	.297148	.012892	90.244	.00095672	6.69704	13.2020	.2732	13.4752	15.422	14.038	29.460	.031410	.028226	.059639	32.318	.06358	64.2
64.3	.607138	15.42128	.298197	.012938	90.566	.00095988	6.71916	13.2045	.2743	13.4788	15.446	14.089	29.535	.031458	.028324	.059779	32.417	.06377	64.3
64.4	.609274	15.47554	.299246	.012984	90.888	.00096304	6.74128	13.2070	.2754	13.4824	15.470	14.140	29.610	.031500	.028422	.059922	32.516	.06396	64.4
64.5	0.611410	15.52980	0.300295	0.013030	91.210	.00096620	6.76340	13.2095	0.2765	13.4860	15.494	14.191	29.685	0.031545	0.028520	0.060065	32.615	0.06415	64.5
64.6	.613546	15.58406	.301344	.013076	91.532	.00096936	6.78552	13.2120	.2776	13.4896	15.518	14.242	29.760	.031590	.028618	.060208	32.714	.06434	64.6
64.7	.615682	15.63832	.302393	.013122	91.854	.00097252	6.80764	13.2145	.2787	13.4932	15.542	14.293	29.835	.031635	.028716	.060351	32.813	.06453	64.7
64.8	.617818	15.69258	.303442	.013168	92.176	.00097568	6.82976	13.2170	.2798	13.4968	15.566	14.344	29.910	.031680	.028814	.060494	32.912	.06472	64.8
64.9	.619954	15.74684	.304491	.013214	92.498	.00097884	6.85188	13.2195	.2809	13.5004	15.590	14.395	29.985	.031725	.028902	.060637	33.011	.06491	64.9
65.0	0.62209	15.8011	0.30554	0.01326	92.82	.0009820	6.8740	13.222	0.282	13.504	15.614	14.446	30.06	0.03177	0.02901	0.06078	33.11	0.0681	65.0
65.1	.624292	15.85703	.306622	.013308	93.156	.00098453	6.8971	13.2245	.283	13.5075	15.6381	14.4989	30.137	.031816	.029111	.060927	33.21	.06529	65.1
65.2	.626494	15.91296	.307704	.013356	93.492	.00098886	6.9202	13.2270	.284	13.5110	15.6622	14.5518	30.214	.031862	.029212	.061074	33.31	.06548	65.2
65.3	.628696	15.96889	.308786	.013404	93.828	.00099319	6.9433	13.2295	.285	13.5145	15.6863	14.6047	30.291	.031908	.029313	.061221	33.41	.06567	65.3
65.4	.630898	16.02482	.309868	.013452	94.164	.00099952	6.9664	13.2320	.286	13.5180	15.7104	14.6576	30.368	.031954	.029414	.061368	33.51	.06586	65.4
65.5	0.633100	16.08075	0.310950	0.013500	94.500	.00099885	6.9895	13.2345	0.287	13.5215	15.7345	14.7105	30.445	0.032000	0.029515	0.061515	33.61	0.06605	65.5
65.6	.635302	16.13668	.312032	.013548	94.836	.00100018	7.0126	13.2370	.288	13.5250	15.7586	14.7634	30.522	.032046	.029616	.061662	33.71	.06624	65.6
65.7	.637504	16.19261	.313114	.013596	95.172	.00100051	7.0357	13.2395	.289	13.5285	15.7827	14.8163	30.599	.032092	.029717	.061809	33.81	.06643	65.7
65.8	.639706	16.24854	.314196	.013644	95.508	.00100084	7.0588	13.2420	.290	13.5320	15.8068	14.8692	30.676	.032138	.029818	.061956	33.91	.06662	65.8
65.9	.641908	16.30447	.315278	.013692	95.844	.00100117	7.0819	13.2445	.291	13.5355	15.8309	14.9221	30.753	.032184	.029919	.062103	34.01	.06681	65.9
66.0	0.64411	16.3604	0.316360	0.01374	96.18	.0010115	7.1050	13.247	0.292	13.539	15.855	14.975	30.83	0.03223	0.30020	0.062250	34.11	0.06700	66.0
66.1	.64638	16.41806	.317474	.01379	96.53	.00101184	7.1288	13.2496	.2931	13.5427	15.879	15.030	30.909	.032276	.030124	.06240	34.21	.06719	66.1
66.2	.64865	16.47572	.318588	.01384	96.88	.00101218	7.1526	13.2522	.2942	13.5464	15.903	15.085	30.988	.032322	.030228	.06255	34.31	.06738	66.2
66.3	.65092	16.53338	.319702	.01389	97.23	.00101252	7.1764	13.2548	.2953	13.5501	15.927	15.140	31.067	.032368	.030332	.06270	34.41	.06757	66.3
66.4	.65319	16.59104	.320816	.01394	97.58	.00101286	7.2002	13.2574	.2964	13.5538	15.951	15.195	31.146	.032414	.030436	.06285	34.51	.06776	66.4
66.5	0.65546	16.64870	0.321930	0.01399	97.93	.00101320	7.2240	13.2600	0.2975	13.5575	15.975	15.250	31.225	0.032461	0.030534	0.06300	34.61	0.06795	66.5
66.6	.65773	16.70636	.323044	.01404	98.28	.00101354	7.2478	13.2626	.2986	13.5612	15.999	15.305	31.304	.032506	.030644	.063150	34.71	.06814	66.6
66.7	.66000	16.76402	.324158	.01409	98.63	.00101388	7.2716	13.2652	.2997	13.5649	16.023	15.360	31.383	.032552	.030748	.06330	34.81	.06833	66.7
66.8	.66227	16.82168	.325272	.01414	98.98	.00101422	7.2954	13.2678	.3008	13.5686	16.047	15.415	31.462	.032598	.030852	.06345	34.91	.06852	66.8
66.9	.66454	16.87934	.326386	.01419	99.33	.00101456	7.3192	13.2704	.3019	13.5723	16.071	15.470	31.541	.032644	.030956	.06360	35.01	.06871	66.9
67.0	0.66681	16.9370	0.32750	0.01424	99.68	.0010149	7.3430	13.273	0.303	13.576	16.095	15.525	31.62	0.03269	0.03106	0.06375	35.11	0.06890	67.0
67.1	.669148	16.99638	.32865	.014291	100.037	.00105525	7.3675	13.2755	.3042	13.5797	16.119	15.581	31.700	.032735	.031167	.063902	35.21	.06909	67.1
67.2	.671486	17.05576	.32980	.014342	100.394	.00105560	7.3920	13.2780	.3054	13.5834	16.143	15.637	31.780	.032780	.031274	.064054	35.31	.06928	67.2
67.3	.673824	17.11514	.33095	.014393	100.751	.00105595	7.4165	13.2805	.3066	13.5871	16.167	15.693	31.860	.032825	.031381	.064206	35.41	.06947	67.3
67.4	.676162	17.17452	.33210	.014444	101.108	.00105630	7.4410	13.2830	.3078	13.5908	16.191	15.749	31.940	.03287	.031488	.064358	35.51	.06965	67.4

67.5	o .678500	17.23390	o .33325	o .014495	101.465	o .0010665	7.4655	13.2855	o .3090	13.5945	16.215	15.805	32.020	0.032915	0.031595	0.064510	35.61	o .06985	67.5
67.6	.680838	17.29328	.33440	.014546	101.822	.0010700	7.4900	13.2880	.3102	13.5982	16.239	15.861	32.100	.03296	.031762	.064662	35.71	.07004	67.6
67.7	.683176	17.35266	.33555	.014597	102.179	.0010735	7.5145	13.2965	.3114	13.6019	16.263	15.917	32.180	.03300	.031809	.064814	35.81	.07023	67.7
67.8	.685514	17.41204	.33670	.014648	102.536	.0010770	7.5390	13.2930	.3126	13.6056	16.287	15.973	32.260	.033050	.031916	.064966	35.91	.07042	67.8
67.9	.687852	17.47142	.33785	.014699	102.893	.0010805	7.5635	13.2955	.3138	13.6093	16.311	16.029	32.340	.033095	.032023	.065118	36.01	.07061	67.9
68.0	o .69019	17.5308	o .33900	o .01475	103.25	o .001084	7.588	13.298	o .315	13.613	16.335	16.085	32.42	o .033140	o .03213	o .06527	36.11	o .07080	68.0
68.1	.692601	17.59204	.340184	.014803	103.621	.0010875	7.6125	13.3005	.3162	13.6167	16.3591	16.1439	32.503	.033186	.03224	.065426	36.21	.07099	68.1
68.2	.695012	17.65328	.341368	.014856	103.992	.0010910	7.6370	13.3030	.3174	13.6204	16.3832	16.2028	32.586	.033232	.03235	.065582	36.31	.07118	68.2
68.3	.697423	17.71452	.342552	.014909	104.363	.0010945	7.6615	13.3055	.3186	13.6241	16.4073	16.2617	32.669	.033278	.03246	.065738	36.41	.07137	68.3
68.4	.699834	17.77576	.343736	.014962	104.734	.0010980	7.6860	13.3080	.3198	13.6278	16.4314	16.3206	32.752	.033324	.03257	.065894	36.51	.07156	68.4
68.5	o .702245	17.83700	o .344920	o .015015	105.105	o .0011015	7.7105	13.3105	o .3210	13.6315	16.4555	16.3795	32.835	o .03370	o .03268	o .066050	36.61	o .07175	68.5
68.6	.704656	17.89824	.346104	.015068	105.476	.0011050	7.7350	13.3130	.3222	13.6352	16.4796	16.4384	32.918	.033416	.03279	.066206	36.71	.07194	68.6
68.7	.707067	17.95948	.347288	.015121	105.847	.0011085	7.7595	13.3155	.3234	13.6389	16.5037	16.4973	33.001	.033462	.03290	.066362	36.81	.07213	68.7
68.8	.709478	18.02072	.348472	.015174	106.218	.0011120	7.7840	13.3180	.3246	13.6426	16.5278	16.5562	33.084	.033508	.03301	.066518	36.91	.07232	68.8
68.9	.711889	18.08196	.349656	.015227	106.589	.0011155	7.8085	13.3205	.3258	13.6463	16.5519	16.6151	33.167	.033554	.03312	.066674	37.01	.07251	68.9
69.0	o .71430	18.1432	o .35084	o .01528	106.96	o .001119	7.8330	13.323	o .327	13.650	16.576	16.674	33.25	o .03360	o .03323	o .066830	37.11	o .07271	69.0
69.1	.716785	18.20632	.35206	.015334	107.338	.0011227	7.8589	13.3255	.3282	13.6537	16.6001	16.734	33.334	.033645	.033344	.066989	37.21	.07289	69.1
69.2	.719270	18.26944	.35328	.015388	107.716	.0011267	7.8848	13.3280	.3294	13.6574	16.624	16.794	33.418	.033690	.033458	.067148	37.31	.07308	69.2
69.3	.721755	18.33256	.35450	.015442	108.094	.0011301	7.9107	13.3305	.3306	13.6611	16.648	16.854	33.502	.033735	.033572	.067307	37.41	.07327	69.3
69.4	.724240	18.39568	.35572	.015496	108.472	.0011338	7.9366	13.3330	.3318	13.6648	16.672	16.914	33.586	.033780	.033686	.067466	37.51	.0746	69.4
69.5	o .726725	18.45880	o .35694	o .015550	108.850	o .0011375	7.9625	13.3355	o .3330	13.6685	16.696	16.974	33.670	o .033825	o .033800	o .067625	37.61	o .07365	69.5
69.6	.729210	18.52192	.35816	.015604	109.228	.0011412	7.9884	13.3380	.3342	13.6722	16.720	17.034	33.754	.033870	.033914	.067784	37.71	.07384	69.6
69.7	.731695	18.58504	.35938	.015658	109.606	.0011449	8.0143	13.3405	.3354	13.6759	16.744	17.094	33.838	.033915	.034028	.067943	37.81	.07403	69.7
69.8	.734180	18.64816	.36060	.015712	109.984	.0011486	8.0402	13.3430	.3366	13.6796	16.768	17.154	33.922	.033960	.034142	.068102	37.91	.07422	69.8
69.9	.736665	18.71128	.36182	.015766	110.362	.0011523	8.0661	13.3455	.3378	13.6833	16.792	17.214	34.006	.034005	.034256	.068261	38.01	.07441	69.9
70.0	o .73915	18.7744	o .36304	o .01582	110.74	o .0011156	8.092	13.348	o .339	13.687	16.816	17.274	34.09	o .03405	o .03437	o .068420	38.11	o .07460	70.0
70.1	.74171	18.83943	.364297	.015877	111.139	.0011598	8.1186	13.3505	.3402	13.6907	16.840	17.336	34.176	.034095	.034487	.068582	38.21	.07479	70.1
70.2	.74427	18.90446	.365554	.015934	111.538	.0011636	8.1452	13.3530	.3414	13.6944	16.864	17.398	34.262	.034140	.034604	.068744	38.31	.07498	70.2
70.3	.74683	18.96949	.366811	.015991	111.937	.0011674	8.1718	13.3555	.3426	13.6981	16.888	17.460	34.348	.034185	.034721	.068906	38.41	.07517	70.3
70.4	.74939	19.03452	.368068	.016048	112.336	.0011712	8.1984	13.3580	.3438	13.7018	16.912	17.522	34.434	.034230	.034838	.069068	38.51	.07536	70.4
70.5	o .75195	19.09955	o .369325	o .016105	112.735	o .0011750	8.2250	13.3605	o .3450	13.7055	16.936	17.584	34.520	o .034275	o .034955	o .069230	38.61	o .07555	70.5
70.6	.75451	19.16458	.370582	.016162	113.134	.0011788	8.2516	13.3630	.3462	13.7092	16.960	17.646	34.606	.034320	.035072	.069392	38.71	.07574	70.6
70.7	.75707	19.22961	.371839	.016219	113.533	.0011826	8.2782	13.3655	.3474	13.7129	16.984	17.708	34.692	.034365	.035189	.069554	38.81	.07593	70.7
70.8	.75963	19.29464	.373096	.016276	113.932	.0011864	8.3048	13.3680	.3486	13.7166	17.008	17.770	34.778	.034410	.035306	.069716	38.91	.07612	70.8
70.9	.76219	19.35967	.374353	.016333	114.331	.0011902	8.3314	13.3705	.3498	13.7203	17.032	17.832	34.864	.034455	.035423	.069878	39.01	.0731	70.9
71.0	o .76475	19.4247	o .37561	o .01639	114.73	o .0011934	8.356	13.373	o .351	13.724	17.056	17.894	34.95	o .03450	o .03554	o .07004	39.11	o .0765	71.0
71.1	.767387	19.49163	.376905	.016448	115.135	.0011979	8.3853	13.3755	.3523	13.7278	17.0891	17.9579	35.038	.034545	.035661	.070206	39.21	.07669	71.1
71.2	.770024	19.55856	.378200	.016506	115.540	.0012018	8.4126	13.3780	.3536	13.7316	17.1042	18.0218	35.126	.034590	.035782	.070372	39.31	.07688	71.2
71.3	.772661	19.62549	.379495	.016564	115.945	.0012057	8.4399	13.3805	.3549	13.7354	17.1283	18.0857	35.214	.034635	.035903	.070538	39.41	.07707	71.3
71.4	.775298	19.69242	.380790	.016622	116.350	.0012096	8.4672	13.3830	.3562	13.7392	17.1524	18.1496	35.302	.034680	.036024	.070704	39.51	.07726	71.4
71.5	o .777935	19.75935	o .382085	o .016680	116.755	o .0012135	8.4945	13.3855	o .3575	13.7430	17.1765	18.2135	35.390	o .034725	o .036145	o .070870	39.61	o .07745	71.5
71.6	.780572	19.82628	.383380	.016738	117.160	.0012174	8.5218	13.3880	.3588	13.7468	17.2006	18.2774	35.478	.034770	.036266	.071036	39.71	.07764	71.6
71.7	.783209	19.89321	.384675	.016796	117.565	.0012213	8.5491	13.3905	.3601	13.7506	17.2247	18.3413	35.566	.034815	.036387	.071202	39.81	.07783	71.7
71.8	.785846	19.96014	.385970	.016854	117.970	.0012252	8.5764	13.3930	.3614	13.7544	17.2488	18.4052	35.654	.034860	.036508	.071368	39.91	.07802	71.8
71.9	.788483	20.02707	.387265	.016912	118.375	.0012291	8.6037	13.3955	.3627	13.7582	17.2729	18.4691	35.742	.034905	.036629	.071534	40.01	.07821	71.9

72.0	0.79112	20.094	0.38856	0.01697	118.78	0.001233	8.631	13.398	0.364	13.762	17.297	18.533	35.83	0.034950	0.03675	0.07170	40.11	0.07784	72.0
72.1	.793836	20.16303	.389894	.017037	119.201	.001237	8.659	13.4006	.3653	13.7659	17.321	18.600	35.921	.034995	.036875	.071870	40.21	.07859	72.1
72.2	.796552	20.23206	.391228	.01709	119.622	.001241	8.687	13.4032	.3666	13.7698	17.345	18.667	36.012	.035040	.037000	.07204	40.31	.07878	72.2
72.3	.799268	20.30109	.392562	.01715	120.043	.001245	8.715	13.4058	.3679	13.7737	17.369	18.734	36.103	.035085	.037125	.07221	40.41	.07897	72.3
72.4	.801984	20.37012	.393896	.01721	120.464	.001249	8.743	13.4084	.3692	13.7776	17.393	18.801	36.194	.035130	.037250	.07238	40.51	.07916	72.4
72.5	0.804700	20.43915	0.395230	0.01727	120.885	0.001253	8.771	13.4110	0.3705	13.7815	17.417	18.868	36.285	0.035175	0.037375	0.07255	40.61	0.07935	72.5
72.6	.807416	20.50818	.396564	.01733	121.306	.001257	8.799	13.4136	.3718	13.7854	17.441	18.935	36.376	.035220	.037500	.07272	40.71	.07954	72.6
72.7	.810132	20.57721	.397898	.01739	121.727	.001261	8.827	13.4162	.3731	13.7893	17.465	19.002	36.467	.035265	.037625	.07289	40.81	.07973	72.7
72.8	.812848	20.64624	.399232	.01745	122.148	.001265	8.855	13.4188	.3744	13.7932	17.489	19.069	36.558	.035310	.037750	.07306	40.91	.07992	72.8
72.9	.815564	20.71527	.400566	.01751	122.569	.001269	8.883	13.4214	.3757	13.7971	17.513	19.136	36.649	.035355	.037875	.07323	41.01	.08011	72.9
73.0	0.81828	20.7843	0.40190	0.01757	122.99	0.001273	8.911	13.424	0.377	13.801	17.537	19.203	36.74	0.035400	0.03800	0.07340	41.11	0.08030	73.0
73.1	.821076	20.85532	.403274	.017632	123.424	.0012771	8.9397	13.4265	.3785	13.805	17.5611	19.2709	36.832	.035445	.038128	.073573	41.209	.08048	73.1
73.2	.823872	20.92634	.404648	.017694	123.858	.0012812	8.9684	13.4290	.3800	13.809	17.5852	19.3388	36.924	.035490	.038256	.073746	41.308	.08066	73.2
73.3	.826668	20.99736	.406022	.017756	124.292	.0012853	8.9971	13.4315	.3815	13.813	17.6093	19.4067	37.016	.035535	.038384	.073919	41.407	.08084	73.3
73.4	.829464	21.06838	.407396	.017818	124.726	.0012894	9.0258	13.4340	.3830	13.817	17.6334	19.4746	37.108	.035580	.038512	.074092	41.506	.08102	73.4
73.5	0.832260	21.13940	0.408770	0.017880	125.160	0.0012935	9.0545	13.4365	0.3845	13.821	17.6575	19.5425	37.200	0.035625	0.038640	0.074265	41.605	0.08120	73.5
73.6	.835056	21.21042	.410144	.017942	125.594	.0012976	9.0832	13.4390	.3860	13.825	17.6816	19.6104	37.292	.035670	.038768	.074438	41.704	.08138	73.6
73.7	.837852	21.28144	.411518	.018004	126.028	.0013017	9.1119	13.4415	.3875	13.829	17.7057	19.6783	37.384	.035715	.038896	.074611	41.803	.08156	73.7
73.8	.840648	21.35246	.412892	.018066	126.462	.0013058	9.1406	13.4440	.3890	13.833	17.7298	19.7462	37.476	.035760	.039024	.074784	41.902	.08174	73.8
73.9	.843444	21.42348	.414266	.018128	126.896	.0013099	9.1693	13.4465	.3905	13.837	17.7539	19.8141	37.568	.035805	.039152	.074957	42.001	.08192	73.9
74.0	0.84624	21.4945	0.41564	0.01819	127.33	0.001314	9.198	13.449	0.392	13.841	17.778	19.882	37.66	0.035850	0.039280	0.07513	42.100	0.08210	74.0
74.1	.84912	21.56733	.417055	.018253	127.771	.0013182	9.2274	13.4515	.3935	13.845	17.802	19.953	37.755	.035895	.039412	.075307	42.2	.08229	74.1
74.2	.85200	21.64016	.418470	.018316	128.212	.0013224	9.2568	13.4540	.3950	13.849	17.826	20.024	37.850	.035940	.039544	.075484	42.3	.08248	74.2
74.3	.85488	21.71299	.419885	.018379	128.653	.0013266	9.2862	13.4565	.3965	13.853	17.850	20.095	37.945	.035985	.039676	.075661	42.4	.08267	74.3
74.4	.85776	21.78582	.421300	.018442	129.094	.0013308	9.3156	13.4590	.3980	13.857	17.874	20.166	38.040	.036030	.039808	.075838	42.5	.08286	74.4
74.5	0.86064	21.85865	0.422715	0.018505	129.535	0.0013350	9.3450	13.4615	0.3995	13.861	17.898	20.237	38.135	0.036075	0.039940	0.076015	42.6	0.08305	74.5
74.6	.86352	21.93148	.424130	.018568	129.976	.0013392	9.3744	13.4640	.4010	13.865	17.922	20.308	38.230	.036120	.040072	.076192	42.7	.08324	74.6
74.7	.86640	22.00431	.425545	.018631	130.417	.0013434	9.4038	13.4665	.4025	13.869	17.946	20.379	38.325	.036165	.040204	.076369	42.8	.08343	74.7
74.8	.86928	22.07714	.426960	.018694	130.858	.0013476	9.4332	13.4690	.4040	13.873	17.970	20.450	38.420	.036210	.040336	.076546	42.9	.08362	74.8
74.9	.87216	22.14997	.428375	.018757	131.299	.0013518	9.4626	13.4715	.4055	13.877	17.994	20.521	38.515	.036255	.040468	.076723	43.0	.08381	74.9
75.0	.87504	22.2228	0.42979	0.01882	131.74	0.001356	9.492	13.474	0.407	13.881	18.018	20.592	38.61	0.036300	0.040600	0.07890	43.1	0.08400	75.0
75.1	.878006	22.29846	.431246	.018886	132.202	.0013603	9.5221	13.4765	.4085	13.885	18.0421	20.6639	38.706	.036345	.040737	.077082	43.2	.08419	75.1
75.2	.880972	22.37412	.432702	.018952	132.664	.0013646	9.5522	13.4790	.4100	13.889	18.0662	20.7358	38.802	.036390	.040874	.077264	43.3	.08438	75.2
75.3	.883938	22.44978	.434158	.019018	133.126	.0013689	9.5823	13.4815	.4115	13.893	18.0903	20.8077	38.898	.036435	.041011	.077446	43.4	.08457	75.3
75.4	.886904	22.52544	.435614	.019084	133.588	.0013732	9.6124	13.4840	.4130	13.897	18.1144	20.8796	38.994	.036480	.041148	.077628	43.5	.08476	75.4
75.5	.889870	22.60110	0.437070	0.019150	134.050	0.0013775	9.6425	13.4865	0.4145	13.901	18.1385	20.9515	39.090	0.036525	0.041285	0.077810	43.6	0.08495	75.5
75.6	.892836	22.67676	.438526	.019216	134.512	.0013818	9.6726	13.4890	.4160	13.905	18.1626	21.0234	39.186	.036570	.041422	.077992	43.7	.08514	75.6
75.7	.895802	22.75242	.439982	.019282	134.974	.0013861	9.7027	13.4915	.4175	13.909	18.1867	21.0953	39.282	.036615	.041559	.078174	43.8	.08533	75.7
75.8	.898768	22.82808	.441438	.019348	135.436	.0013904	9.7328	13.4940	.4190	13.913	18.2108	21.1672	39.378	.036660	.041696	.078356	43.9	.08552	75.8
75.9	.901734	22.90374	.442894	.019414	135.898	.0013947	9.7629	13.4965	.4205	13.917	18.2349	21.2391	39.474	.036705	.041833	.078538	44.0	.08571	75.9
76.0	.90470	22.9794	0.44435	0.01948	136.36	0.001399	9.793	13.499	0.422	13.921	18.259	21.311	39.157	0.036750	0.041970	0.078720	44.1	0.08590	76.0
76.1	.907753	23.05594	.44585	.019548	136.836	.0014035	9.8245	13.5016	.4235	13.9251	18.283	21.387	39.67	.036795	.04211	.078905	44.2	.08608	76.1
76.2	.910806	23.13248	.44735	.019616	137.312	.0014080	9.8560	13.5042	.4250	13.9292	18.307	21.463	39.77	.036840	.04225	.079090	44.3	.08626	76.2
76.3	.913859	23.20902	.44885	.019684	137.788	.0014125	9.8875	13.5068	.4265	13.9333	18.331	21.539	39.87	.036885	.04239	.079275	44.4	.08644	76.3
76.4	.916912	23.28556	.45035	.019752	138.264	.0014170	9.9190	13.5094	.4280	13.9374	18.355	21.615	39.97	.036930	.04253	.079460	44.5	.08662	76.4

76.5	0.919965	23.36210	0.45185	0.019820	138.740	0.0014215	9.9505	13.5120	0.4295	13.9415	18.379	21.691	40.07	0.036975	0.04267	0.079645	44.6	0.0868	76.5
76.6	.923018	23.43864	.45335	.019888	139.216	.0014260	9.9820	13.5146	.4310	13.9456	18.403	21.767	40.17	.037020	.04281	.079830	44.7	.08698	76.6
76.7	.926071	23.51518	.45485	.019986	139.692	.0014305	10.0135	13.5172	.4325	13.9497	18.427	21.843	40.27	.037065	.04295	.080015	44.8	.08716	76.7
76.8	.929124	23.59172	.45635	.020024	140.168	.0014350	10.0450	13.5198	.4340	13.9538	18.451	21.919	40.37	.037110	.04309	.080290	44.9	.08734	76.8
76.9	.932177	23.66826	.45785	.020092	140.644	.0014395	10.0765	13.5224	.4355	13.9579	18.475	21.995	40.47	.037155	.04323	.080385	45.0	.08752	76.9
77.0	0.93523	23.7448	0.45935	0.02016	141.12	0.001444	10.108	13.525	0.437	13.962	18.499	22.071	40.57	0.037220	0.04337	0.08057	45.1	0.0877	77.0
77.1	.938372	23.82561	.460853	.02023	141.61	.0014486	10.1402	13.5275	.4386	13.9661	18.5231	22.1479	40.671	.037245	.043515	.08076	45.2	.08789	77.1
77.2	.941514	23.90642	.462436	.02030	142.10	.0014532	10.1724	13.5300	.4402	13.9702	18.5472	22.2248	40.772	.037290	.043660	.08095	45.3	.08808	77.2
77.3	.944656	23.98723	.463979	.02037	142.59	.0014578	10.2046	13.5325	.4418	13.9743	18.5713	22.3017	40.873	.037335	.043805	.08114	45.4	.08827	77.3
77.4	.947798	24.06804	.465522	.02044	143.08	.0014624	10.2368	13.5350	.4434	13.9784	18.5954	22.3786	40.974	.037380	.043950	.08133	45.5	.08846	77.4
77.5	0.950940	24.14885	0.467065	0.02051	143.57	0.0014670	10.2690	13.5375	0.4450	13.9825	18.6195	22.4555	41.075	0.037425	0.044095	0.08152	45.6	0.08865	77.5
77.6	.954082	24.22966	.468608	.02058	144.06	.0014716	10.3012	13.5400	.4466	13.9866	18.6436	22.5324	41.176	.037470	.044240	.08171	45.7	.08884	77.6
77.7	.957224	24.31047	.470151	.02065	144.55	.0014762	10.3334	13.5425	.4482	13.9907	18.6677	22.6093	41.277	.037515	.044385	.08190	45.8	.08903	77.7
77.8	.960366	24.39128	.471694	.02072	145.04	.0014808	10.3656	13.5450	.4498	13.9948	18.6918	22.6862	41.378	.037560	.044530	.08209	45.9	.08922	77.8
77.9	.963508	24.47209	.473237	.02079	145.53	.0014854	10.3978	13.5475	.4514	13.9989	18.7159	22.7631	41.479	.037605	.044675	.08228	46.0	.08941	77.9
78.0	.96665	24.5529	0.47478	0.02086	146.02	0.001490	10.430	13.550	0.453	14.003	18.740	22.84	41.58	0.03765	0.04482	0.08247	46.1	0.0896	78.0
78.1	.969884	24.63514	.476368	.020932	146.524	.0014946	10.4622	13.5525	.4547	14.0072	18.764	22.920	41.684	.037695	.044969	.082664	46.2	.08978	78.1
78.2	.973118	24.71738	.477956	.021004	147.028	.0014992	10.4944	13.5550	.4564	14.0114	18.788	23.000	41.788	.037740	.045118	.082858	46.3	.08996	78.2
78.3	.976352	24.79962	.479544	.021076	147.532	.0015038	10.5266	13.5575	.4581	14.0156	18.812	23.08	41.892	.037785	.045267	.083052	46.4	.09014	78.3
78.4	.979586	24.88186	.481132	.021148	148.036	.0015084	10.5588	13.5600	.4598	14.0198	18.836	23.16	41.996	.037830	.045416	.083246	46.5	.09032	78.4
78.5	.982820	24.96410	0.482720	0.021220	148.540	0.0015130	10.5910	13.5625	0.4615	14.0240	18.860	23.24	42.100	0.037875	0.045565	0.083440	46.6	0.09050	78.5
78.6	.986054	25.04634	.484308	.021292	149.044	.0015176	10.6232	13.5650	.4632	14.0282	18.884	2332	42.204	.037920	.045714	.083634	46.7	.09068	78.6
78.7	.989288	25.12858	.485896	.021364	149.548	.0015222	10.6554	13.5675	.4649	14.0324	18.908	23.40	42.308	.037965	.045863	.083828	46.8	.09086	78.7
78.8	.992522	25.21082	.487484	.021436	150.052	.0015268	10.6876	13.5700	.4666	14.0366	18.932	23.48	42.412	.038010	.046012	.084022	46.9	.09104	78.8
78.9	.995756	25.29306	.489072	.021508	150.556	.0015314	10.7198	13.5725	.4683	14.0408	18.956	23.56	42.516	.038055	.046161	.084216	47.0	.09122	78.9
79.0	.99899	25.3753	0.49066	0.02158	151.08	0.001536	10.7520	13.575	0.470	14.045	18.980	23.64	42.62	0.038100	0.04631	0.084410	47.1	0.0914	79.0
79.1	1.002321	25.47981	.492295	.021655	151.585	.0015408	10.7856	13.5776	.4716	14.0492	19.0041	23.7224	42.727	.038144	.046463	.084607	47.2	.09159	79.1
79.2	1.005652	25.54432	.493930	.021730	152.110	.0015456	10.8192	13.5802	.4732	14.0534	19.0282	23.8058	42.834	.038188	.046616	.084804	47.3	.09178	79.2
79.3	1.008983	25.62883	.495565	.021805	152.635	.0015504	10.8528	13.5828	.4748	14.0576	19.0523	23.8887	42.941	.038232	.046769	.085001	47.4	.09197	79.3
79.4	1.012314	25.71334	.497200	.021880	153.160	.0015552	10.8864	13.5854	.4764	14.0618	19.0764	23.9716	43.048	.038276	.046922	.085198	47.5	.09216	79.4
79.5	1.015645	25.79785	0.498835	0.021955	153.685	0.0015600	10.9200	13.5880	0.4780	14.0660	19.1005	24.0545	43.155	0.038320	0.047075	0.085395	47.6	0.09235	79.5
79.6	1.018976	25.88236	.500470	.022030	154.210	.0015648	10.9536	13.5906	.4796	14.0702	19.1246	24.1374	43.262	.038364	.047228	.085592	47.7	.09254	79.6
79.7	1.022307	25.96687	.502105	.022105	154.735	.0015696	10.9872	13.5932	.4812	14.0744	19.1487	24.2203	43.369	.038408	.047381	.085789	47.8	.09273	79.7
79.8	1.025638	26.05138	.503740	.022180	155.260	.0015744	11.0208	13.5958	.4828	14.0786	19.1728	24.3032	43.476	.038452	.047534	.085986	47.9	.09292	79.8
79.9	1.028969	26.13589	.505375	.022255	155.785	.0015792	11.0544	13.5984	.4844	14.0828	19.1969	24.3861	43.583	.038496	.047687	.086183	48.0	.09311	79.9
80.1	1.0323	26.2204	0.507011	0.02233	156.31	0.001584	11.088	13.601	0.486	14.087	19.221	24.469	43.69	0.038540	0.047840	0.08638	48.1	0.0933	80.0
80.1	1.03572	26.30727	.508691	.022407	156.849	.001589	11.123	13.6035	.4878	14.0913	19.245	24.554	43.799	.038585	.047998	.086583	48.195	.09349	80.1
80.2	1.03914	26.39414	.510372	.022484	157.388	.001594	11.158	13.6060	.4896	14.0956	19.269	24.639	43.908	.038630	.048156	.086786	48.298	.09368	80.2
80.3	1.04256	26.48101	.512053	.022561	157.927	.001599	11.193	13.6085	.4914	14.0999	19.293	24.724	44.017	.038675	.048314	.086989	48.397	.09387	80.3
80.4	1.04598	26.56788	.513734	.022638	158.466	.001604	11.228	13.6110	.4932	14.1042	19.317	24.809	44.126	.038720	.048472	.087192	48.496	.09406	80.4
80.5	1.04940	26.65475	0.515415	0.022715	159.005	0.001609	11.263	13.6135	0.4950	14.1085	19.341	24.894	44.235	0.038765	0.048630	0.087395	48.595	0.09425	80.5
80.6	1.05282	26.74162	.517096	.022792	159.544	.001614	11.298	13.6160	.4968	14.1128	19.365	24.979	44.344	.038810	.048788	.087598	48.694	.09444	80.6
80.7	1.05624	26.82849	.518777	.022869	160.083	.001619	11.333	13.6185	.4986	14.1171	19.389	25.064	44.453	.038855	.048946	.087801	48.793	.09463	80.7
80.8	1.05966	26.91536	.520458	.022946	160.622	.001624	11.368	13.6210	.5004	14.1214	19.413	25.149	44.562	.038900	.049104	.088004	48.892	.09482	80.8
80.9	1.06308	27.00223	.522139	.023023	161.161	.001629	11.403	13.6235	.5022	14.1257	19.437	25.234	44.671	.038945	.049262	.088207	48.991	.09501	80.9

81.0	1.0665	27.0891	0.52382	0.02310	161.70	0.001634	11.438	13.626	0.504	14.130	19.461	25.319	44.78	0.038990	0.04942	0.08841	49.09	0.09520	81.0
81.1	1.07001	27.17851	.52555	.023179	162.253	.0016391	11.4737	13.6285	.5059	14.1344	19.4851	25.4069	44.892	.039034	.049583	.088617	49.19	.09538	81.1
81.2	1.07352	27.26792	.52728	.023258	162.806	.0016442	11.5094	13.6310	.5078	14.1388	19.5092	25.4948	45.004	.039078	.049746	.088824	49.29	.09556	81.2
81.3	1.07703	27.35733	.52901	.023337	163.359	.0016493	11.5451	13.6335	.5097	14.1432	19.5333	25.5827	45.116	.039122	.049909	.089031	49.39	.09574	81.3
81.4	1.08054	27.44674	.53074	.023416	163.912	.0016544	11.5808	13.6360	.5116	14.1476	19.5574	25.6706	45.228	.039166	.050072	.089238	49.49	.09592	81.4
81.5	1.08405	27.53615	0.53247	0.023495	164.465	0.0016595	11.6165	13.6385	0.5135	14.1520	195.815	25.7585	45.340	0.039210	0.050235	0.089445	49.59	0.09610	81.5
81.6	1.08756	27.62556	.53420	.023574	165.018	.0016646	11.6522	13.6410	.5154	14.1564	19.6056	25.8464	45.452	.039254	.050398	.089652	49.69	.09628	81.6
81.7	1.09107	27.71497	.53593	.023653	165.571	.0016697	11.6879	13.6435	.5173	14.1608	19.6297	25.9343	45.564	.039298	.050561	.089859	49.79	.09646	81.7
81.8	1.09458	27.80438	.53766	.023732	166.124	.0016748	11.7236	13.6460	.5192	14.1652	19.6538	26.0222	45.676	.039342	.050724	.090066	49.89	.09664	81.8
81.9	1.09809	27.89379	.53939	.023811	166.677	.0016799	11.7593	13.6485	.5211	14.1696	19.6779	26.1101	45.788	.039386	.050887	.090273	49.99	.09682	81.9
82.0	1.1017	27.9832	0.54112	0.02389	167.23	0.001685	11.7950	13.651	0.523	14.174	19.702	26.198	45.90	0.03943	0.051050	0.090480	50.09	0.0970	82.0
82.1	1.10532	28.07515	.54290	.023972	167.804	.0016903	11.8321	13.6535	.5249	14.1784	19.726	26.288	46.014	.039474	.051218	.090692	50.19	.09719	82.1
82.2	1.10894	28.16710	.54468	.024054	168.378	.0016956	11.8692	13.6560	.5268	14.1828	19.750	26.378	46.128	.039518	.051386	.090904	50.29	.09738	82.2
82.3	1.11256	28.25905	.54646	.024136	168.952	.0017009	11.9063	13.6585	.5287	14.1872	19.774	26.468	46.242	.039562	.051554	.091116	50.39	.09757	82.3
82.4	1.11618	28.35100	.54824	.024218	169.526	.0017062	11.9434	13.6610	.5306	14.1916	19.798	26.558	46.356	.039606	.051722	.091328	50.49	.09776	82.4
82.5	1.11980	28.44295	0.55002	0.024300	170.100	0.0017115	11.9805	13.6635	0.5325	14.1960	19.822	26.648	46.470	0.039650	0.051890	0.091549	50.59	0.09795	82.5
82.6	1.12342	28.53490	.55180	.024382	170.674	.0017168	12.0176	13.6660	.5349	14.2004	19.846	26.738	46.584	.039694	.052058	.091752	50.69	.09814	82.6
82.7	1.12704	28.62685	.55358	.024464	171.248	.0017221	12.0547	13.6685	.5363	14.2048	19.870	26.828	46.698	.039738	.052226	.091964	50.79	.09833	82.7
82.8	1.13066	28.71880	.55536	.024546	171.822	.0017274	12.0918	13.6710	.5382	14.2092	19.894	26.918	46.812	.039782	.052394	.092176	50.89	.09852	82.8
82.9	1.13428	28.81075	.55714	.024628	172.396	.0017327	12.1289	13.6735	.5401	14.2136	19.918	27.008	46.926	.039826	.052562	.092388	50.99	.09871	82.9
83.0	1.1379	28.9027	0.55892	0.024791	172.97	0.001738	12.166	13.676	0.542	14.218	19.942	27.098	47.04	0.03987	0.05273	0.09260	51.09	0.0989	83.0
83.1	1.14163	28.99744	.56075	.024794	173.558	.0017433	12.2031	13.6786	.5438	14.2224	19.9661	27.1919	47.158	.039914	.052903	.092817	51.19	.09908	83.1
83.2	1.14536	29.09218	.56258	.024878	174.146	.0017486	12.2402	13.6812	.5456	14.2268	19.9902	27.2858	47.276	.039958	.053076	.093034	51.29	.09926	83.2
83.3	1.14909	29.18692	.56441	.024962	174.734	.0017539	12.2773	13.6838	.5474	14.2312	20.0143	27.3797	47.394	.040002	.053249	.093251	51.39	.09944	83.3
83.4	1.15282	29.28166	.56624	.025046	175.322	.0017592	12.3144	13.6864	.5492	14.2356	20.0384	27.4736	47.512	.040046	.053422	.093468	51.49	.09962	83.4
83.5	1.15655	29.37640	0.56807	0.025130	175.910	0.0017645	12.3515	13.6890	0.5510	14.2400	20.0625	27.5675	47.630	0.040090	0.053595	0.093685	51.59	0.09980	83.5
83.6	1.16028	29.47114	.56990	.025214	176.498	.0017698	12.3886	13.6916	.5528	14.2444	20.0866	27.6114	47.748	.040134	.053768	.093902	51.69	.09998	83.6
83.7	1.16401	29.56588	.57173	.025298	177.086	.0017751	12.4257	13.6942	.5546	14.2486	20.1107	27.7553	47.866	.040178	.053941	.094119	51.79	.10016	83.7
83.8	1.16774	29.66062	.57356	.025382	177.674	.0017804	12.4628	13.6968	.5564	14.2532	20.1348	27.8492	47.984	.040222	.054114	.094336	51.89	.10034	83.8
83.9	1.17147	29.75536	.57539	.025466	178.262	.0017857	12.4999	13.6994	.5582	14.2576	20.1589	27.9431	48.102	.040266	.054287	.094553	51.99	.10052	83.9
84.0	1.1752	29.8501	0.57722	0.02555	178.85	0.001791	12.5370	13.702	0.560	14.262	20.183	28.037	48.22	0.04031	0.05446	0.09477	52.09	0.1007	84.0
84.1	1.17903	29.94738	.579102	.025637	179.459	.0017966	12.5762	13.7045	.5621	14.2666	20.207	28.134	48.341	.040354	.054638	.094992	52.19	.10088	84.1
84.2	1.18286	30.04466	.580984	.025724	180.006	.0018022	12.6154	13.7070	.5642	14.2712	20.231	28.231	48.462	.040398	.054816	.095214	52.29	.10106	84.2
84.3	1.18669	30.14194	.582866	.025811	180.677	.0018078	12.6546	13.7095	.5663	14.2758	20.255	28.328	48.583	.040442	.054994	.095436	52.39	.10124	84.3
84.4	1.19052	30.23922	.584748	.025898	181.286	.0018134	12.6938	13.7120	.5684	14.2804	20.279	28.425	48.704	.040486	.055172	.095658	52.49	.10142	84.4
84.5	1.19435	30.33650	0.586630	0.025985	181.895	0.0018190	12.7330	13.7145	0.5705	14.2850	20.303	28.522	48.825	0.040530	0.055350	0.095880	52.59	0.10160	84.5
84.6	1.19818	30.43378	.588512	.026072	182.504	.0018246	12.7722	13.7170	.5726	14.2896	20.327	28.619	48.946	.040574	.055528	.096102	52.69	.10178	84.6
84.7	1.20201	30.53106	.590394	.026159	183.113	.0018302	12.8114	13.7195	.5747	14.2942	20.351	28.716	49.067	.040618	.055706	.096324	52.79	.10196	84.7
84.8	1.20584	30.62834	.592276	.026246	183.722	.0018358	12.8506	13.7220	.5768	14.2988	20.375	28.813	49.188	.040662	.055884	.096546	52.89	.10214	84.8
84.9	1.20967	30.72562	.594158	.026333	184.331	.0018414	12.8895	13.7245	.5789	14.3034	20.399	28.910	49.309	.040706	.056062	.096768	52.99	.10232	84.9
85.0	1.2135	30.8229	0.59604	0.02642	184.94	0.001847	12.929	13.727	0.581	14.308	20.423	29.007	49.43	0.040750	0.05624	0.09699	53.09	0.10250	85.0
85.1	1.21744	30.92298	.597976	.026509	185.563	.0018526	12.9682	13.7295	.5831	14.3126	20.447	29.106	49.553	.040794	.056423	.097217	53.189	.10268	85.1
85.2	1.22138	31.02306	.599912	.026598	186.186	.0018582	13.0074	13.7320	.5852	14.3172	20.471	29.205	49.676	.040838	.056606	.097444	53.288	.10286	85.2
85.3	1.22532	31.12314	.601848	.026687	186.809	.0018638	13.0466	13.7345	.5873	14.3218	20.495	29.304	49.799	.040882	.056789	.097671	53.387	.10304	85.3
85.4	1.22926	31.22322	.603784	.026776	187.432	.0018694	13.0858	13.7370	.5894	14.3264	20.519	29.403	49.922	.040926	.056972	.097898	53.486	.10322	85.4

85.5	1.23320	31.32330	0.605720	0.026865	188.055	0.0018750	13.1250	13.7395	0.5915	14.3310	20.543	29.502	50.045	0.040970	0.057155	0.098125	53.585	0.10340	85.5
85.6	1.23714	31.42338	.607656	.026954	188.678	.0018806	13.1642	13.7420	.5936	14.3356	20.567	29.601	50.168	.041014	.057338	.098352	53.684	.10358	85.6
85.7	1.24108	31.52346	.609592	.027043	189.301	.0018862	13.2034	13.7445	.5957	14.3402	20.591	29.700	50.291	.041058	.057521	.098579	53.783	.10376	85.7
85.8	1.24502	31.62354	.611528	.027132	189.924	.0018918	13.2426	13.7470	.5978	14.3448	20.615	29.799	50.414	.041102	.057704	.098806	53.882	.10394	85.8
85.9	1.24896	31.72362	.613464	.027221	190.547	.0018974	13.2818	13.7495	.5999	14.3494	20.639	29.898	50.537	.041146	.057887	.099033	53.981	.10412	85.9
86.0	1.25291	31.82371	0.615401	0.027310	191.17	0.0019030	13.3210	13.7520	0.6020	14.3540	20.663	29.997	50.66	0.041190	0.058070	0.099260	54.080	0.10430	86.0
86.1	1.25695	31.92667	.61739	.027403	191.821	.0019088	13.3616	13.7545	.6042	14.3587	20.6871	30.0999	50.789	.041234	.058258	.099492	54.18	.10449	86.1
86.2	1.26100	32.02964	.61938	.027496	192.472	.0019146	13.4022	13.7570	.6064	14.3634	20.7112	30.2028	50.914	.041278	.058446	.099724	54.28	.10468	86.2
86.3	1.26505	32.13261	.62137	.027589	193.123	.0019204	13.4428	13.7595	.6086	14.3681	20.7353	30.3057	51.041	.041322	.058634	.099956	54.38	.10487	86.3
86.4	1.26910	32.23558	.62336	.027682	193.774	.0019262	13.4834	13.7620	.6108	14.3728	20.7594	30.4086	51.168	.041366	.058822	.100188	54.48	.10506	86.4
86.5	1.27315	32.33855	0.625230	0.027775	194.425	0.0019320	13.5240	13.7645	0.6130	14.3775	20.7835	30.5115	51.295	0.041410	0.059010	0.100420	54.58	0.10525	86.5
86.6	1.27720	32.44152	.62734	.027868	195.076	.0019378	13.5646	13.7670	.6152	14.3822	20.8076	30.6144	51.422	.041454	.059198	.100652	54.68	.10544	86.6
86.7	1.28125	32.54449	.62933	.027961	195.727	.0019436	13.6052	13.7695	.6174	14.3869	20.8317	30.7173	51.549	.041498	.059386	.100884	54.78	.10563	86.7
86.8	1.28530	32.64746	.63132	.028054	196.378	.0019494	13.6458	13.7720	.6196	14.3916	20.8558	30.8202	51.676	.041542	.059574	.101116	54.88	.10582	86.8
86.9	1.28935	32.75043	.63331	.028147	197.029	.0019552	13.6864	13.7745	.6218	14.3963	20.8799	30.9231	51.803	.041586	.059762	.101348	54.98	.10601	86.9
87.0	1.2934	32.8534	0.63530	0.028247	197.68	0.001961	13.727	13.777	0.624	14.401	20.904	31.026	51.93	0.041630	0.059950	0.10158	55.08	0.1062	87.0
87.1	1.29757	32.95921	.637345	.028335	198.345	.0019669	13.7683	13.7796	.6261	14.4057	20.928	31.132	52.060	.041674	.060144	.101818	5518	.10638	87.1
87.2	1.30174	33.06502	.639390	.028430	199.010	.0019728	13.8096	13.7822	.6282	14.4104	20.952	31.238	52.190	.041718	.060338	.102056	55.28	.10656	87.2
87.3	1.30591	33.17083	.641435	.028525	199.675	.0019787	13.8509	13.7848	.6303	14.4151	20.976	31.344	52.320	.041762	.060532	.102294	55.38	.10674	87.3
87.4	1.31008	33.27664	.643480	.028620	200.340	.0019846	13.8922	13.7874	.6324	14.4198	21.000	31.450	52.450	.041806	.060726	.102532	55.48	.10692	87.4
87.5	1.31425	33.38245	0.645525	0.028715	201.005	0.0019905	13.9335	13.7900	0.6345	14.4245	21.024	31.556	52.580	0.041850	0.060920	0.102770	55.58	0.10710	87.5
87.6	1.31842	33.48826	.647570	.028810	201.670	.0019964	13.9748	13.7926	.6366	14.4292	21.048	31.662	52.710	.041894	.061114	.103008	55.68	.10728	87.6
87.7	1.32259	33.59407	.649615	.028905	202.335	.0020023	14.0161	13.7952	.6387	14.4339	21.072	31.768	52.840	.041938	.061308	.103246	55.78	.10746	87.7
87.8	1.32676	33.69988	.651660	.029000	203.000	.0020082	14.0574	13.7978	.6408	14.4386	21.096	31.874	52.970	.041982	.061502	.103484	55.88	.10764	87.8
87.9	1.33093	33.80569	.653705	.029095	203.665	.0020141	14.0987	13.8004	.6429	14.4433	21.120	31.980	53.100	.042026	.061696	.103722	55.98	.10782	87.9
88.0	1.3351	33.9115	0.655750	0.02919	204.33	0.002020	14.1400	13.803	0.645	14.448	21.144	32.086	53.23	0.042070	0.061890	0.103960	56.08	0.10800	88.0
88.1	1.33938	34.01909	.657853	.029288	205.016	.0020261	14.1827	13.8055	.6473	14.4528	21.1681	32.1949	53.363	.042114	.06209	.104204	56.18	.10818	88.1
88.2	1.34366	34.12668	.659956	.029386	205.702	.0020322	14.2254	13.8080	.6496	14.4576	21.1922	32.3038	53.496	.042158	.06229	.104448	56.28	.10836	88.2
88.3	1.34794	34.23427	.662059	.029484	206.388	.0020383	14.2681	13.8105	.6519	14.4624	21.2163	32.4127	53.629	.042202	.06249	.104692	56.38	.10854	88.3
88.4	1.35222	34.34186	.664162	.029582	207.074	.0020444	14.3108	13.8130	.6542	14.4672	21.2404	32.5216	53.762	.042246	.06269	.104936	56.48	.10872	88.4
88.5	1.35650	34.44945	0.666265	0.029680	207.760	0.0020505	14.3535	13.8155	0.6565	14.4720	21.2645	32.6305	53.895	0.042290	0.06289	0.105180	56.58	0.10890	88.5
88.6	1.36078	34.55704	.668368	.029778	208.446	.0020566	14.3962	13.8180	.6588	14.4768	21.2886	32.7394	54.028	.042334	.06309	.105424	56.68	.10908	88.6
88.7	1.36506	34.66463	.670471	.029876	209.132	.0020629	14.4389	13.8205	.6611	14.4816	21.3127	32.8483	54.161	.042378	.06329	.105668	56.78	.10926	88.7
88.8	1.36934	34.77222	.672574	.029974	209.818	.0020688	14.4816	13.8230	.6634	14.4864	21.3368	32.9572	54.294	.042422	.06349	.105912	56.88	.10944	88.8
88.9	1.37362	34.87981	.674677	.030072	210.504	.0020749	14.5243	13.8255	.6657	14.4912	21.3609	33.0661	54.427	.042466	.06369	.106156	56.98	.10962	88.9
89.0	1.3779	34.9874	0.67678	0.03017	211.19	0.0020781	14.567	13.828	0.668	14.496	21.385	33.175	54.56	0.04251	0.06389	0.10640	57.08	0.10980	89.0
89.1	1.38230	35.10028	.67894	.030271	211.897	.0020873	14.6111	13.8305	.6704	14.5009	21.409	33.288	54.697	.042554	.064097	.106651	57.18	.10998	89.1
89.2	1.38670	35.21316	.68110	.030372	212.604	.0020936	14.6552	13.8330	.6728	14.5058	21.433	33.401	54.834	.042598	.064304	.106902	57.28	.11016	89.2
89.3	1.39110	35.32604	.68326	.030473	213.311	.0020999	14.6993	13.8355	.6752	14.5107	21.457	33.514	54.971	.042642	.064511	.107153	57.38	.11034	89.3
89.4	1.39550	35.43892	.68542	.030574	214.018	.0021062	14.7434	13.8380	.6776	14.5156	21.481	33.627	55.108	.042686	.064718	.107404	57.48	.11052	89.4
89.5	1.39990	35.55180	0.68758	0.030675	214.725	0.0021125	14.7875	13.8405	0.6800	14.5205	21.505	33.740	55.245	0.042730	0.064925	0.107655	57.58	0.11070	89.5
89.6	1.40430	35.66468	.68974	.030776	215.432	.0021188	14.8316	13.8430	.6824	14.5254	21.529	33.853	55.382	.042774	.065132	.108906	57.68	.11088	89.6
89.7	1.40870	35.77756	.69190	.030877	216.139	.0021251	14.8757	13.8455	.6848	14.5305	21.553	33.966	55.519	.042818	.065335	.108157	57.78	.11106	89.7
89.8	1.41310	35.89044	.69406	.030978	216.846	.0021314	14.9198	13.8480	.6872	14.5352	21.577	34.079	55.656	.042862	.065546	.108408	57.88	.11124	89.8
89.9	1.41750	36.00332	.69622	.031079	217.553	.0021377	14.9639	13.8505	.6896	14.5401	21.601	34.192	55.793	.042906	.065753	.108659	57.98	.11142	89.9

90.0	1.4219	36.11626	0.69838	0.03118	218.26	0.002144	15.008	13.853	0.692	14.545	21.625	34.305	55.93	0.042450	0.065960	0.108910	58.08	0.1116	90.0
90.1	1.42642	36.23101	.700601	.031285	218.995	.0021504	15.0527	13.8556	.6944	14.5500	21.649	34.421	56.070	.042994	.066171	.109165	58.179	.11179	90.1
90.2	1.43094	36.34582	.702822	.031398	219.730	.0021568	15.0974	13.8582	.6968	14.5550	21.673	34.537	56.21	.043038	.066382	.109420	58.278	.11198	90.2
90.3	1.43546	36.46063	.705043	.031495	220.465	.0021632	15.1421	13.8608	.6992	14.5600	21.697	34.653	56.35	.043062	.066593	.109675	58.377	.11217	90.3
90.4	1.43998	36.57544	.707264	.031600	221.200	.0021696	15.1868	13.8634	.7016	14.5650	21.721	34.765	56.49	.043126	.066804	.109930	58.476	.11236	90.4
90.5	1.44450	36.69025	0.709485	0.031705	221.935	0.0021760	15.2315	13.8660	0.7040	14.5700	21.745	34.885	56.63	0.043170	0.067015	0.110185	58.575	0.11255	90.5
90.6	1.44902	36.80506	.711706	.031810	222.670	.0021824	15.2762	13.8686	.7064	14.5750	21.769	35.001	56.77	.043214	.067226	.110440	58.674	.11274	90.6
90.7	1.45354	36.91987	.713927	.031915	223.405	.0021888	15.3209	13.8712	.7088	14.5800	21.793	35.117	56.91	.043258	.067437	.110695	58.773	.11293	90.7
90.8	1.45806	37.03468	.716148	.032020	224.140	.0021952	15.3656	13.8738	.7112	14.5850	21.817	35.233	57.05	.043302	.067648	.110950	58.872	.11312	90.8
90.9	1.46258	37.14949	.718369	.032125	224.875	.0022016	15.4103	13.8764	.7136	14.5900	21.841	35.349	57.19	.043346	.067859	.111205	58.971	.11331	90.9
91.0	1.4671	37.2643	0.72059	0.03223	225.61	0.002208	15.455	13.879	0.716	14.595	21.865	35.465	57.33	0.043390	0.068070	0.111460	59.07	0.11350	91.0
91.1	1.47174	37.38216	.722871	.032337	226.359	.0022146	15.5013	13.8815	.7185	14.6000	21.8891	35.5859	57.475	.043433	.068288	.111721	59.17	.11368	91.1
91.2	1.47638	37.50002	.725152	.032444	227.108	.0022212	15.5476	13.8840	.7210	14.6050	21.9132	35.7068	57.610	.043476	.068506	.111982	59.27	.11386	91.2
91.3	1.48102	37.61788	.727433	.032551	227.857	.0022278	15.5939	13.8865	.7235	14.6100	21.9373	35.8277	57.765	.043519	.068724	.112243	59.37	.11404	91.3
91.4	1.48566	37.73574	.729714	.032658	228.606	.0022344	15.6402	13.8890	.7260	14.6150	21.9614	35.9486	57.910	.043562	.068942	.112504	59.47	.11422	91.4
91.5	1.49030	37.85360	0.731995	0.032765	229.355	0.0022410	15.6865	13.8915	0.7285	14.6250	21.9855	36.0695	58.055	0.043605	0.069160	0.112765	59.57	0.1144	91.5
91.6	1.49494	37.97146	.734276	.032872	230.104	.0022476	15.7328	13.8940	.7310	14.6250	22.0096	36.1904	58.200	.043648	.069378	.113026	59.67	.11458	91.6
91.7	1.49958	38.08932	.736557	.032979	230.853	.0022542	15.7791	13.8965	.7335	14.6300	22.0337	36.3113	58.345	.043691	.069596	.113287	59.77	.11476	91.7
91.8	1.50422	38.20718	.738838	.033086	231.602	.0022608	15.8254	13.8990	.7360	14.6350	22.0578	36.4322	58.490	.043734	.069814	.113548	59.87	.11494	91.8
91.9	1.50886	38.32504	.741119	.033193	232.351	.0022674	15.8717	13.9015	.7385	14.6400	22.0819	36.5531	58.635	.043777	.070032	.113809	59.97	.11512	91.9
92.0	1.5135	38.44229	0.74340	0.03330	233.10	0.002274	15.918	13.904	0.741	14.645	22.106	36.674	58.78	0.043820	0.070250	0.114070	60.07	0.1153	92.0
92.1	1.51827	38.56406	.745744	.033411	233.877	.0022807	15.9649	13.9065	.7437	14.6502	22.130	36.797	58.927	.043864	.070474	.114338	60.17	.11548	92.1
92.2	1.52304	38.68522	.748088	.033527	234.654	.0022874	16.0118	13.9090	.7464	14.6554	22.154	36.920	59.074	.043908	.070698	.114606	60.27	.11566	92.2
92.3	1.52781	38.80638	.750432	.033633	235.431	.0022941	16.0587	13.9115	.7491	14.6606	22.178	37.043	59.221	.043952	.070922	.114874	60.37	.11584	92.3
92.4	1.53258	38.92754	.752776	.033744	236.208	.0023008	16.1056	13.9140	.7518	14.6658	22.202	37.166	59.368	.043996	.071146	.115142	60.47	.11602	92.4
92.5	1.53735	39.04879	0.755120	0.033855	236.985	0.0023075	16.1525	13.9165	0.7545	14.6710	22.226	37.289	59.515	0.044040	0.071370	0.115410	60.57	0.11620	92.5
92.6	1.54212	39.16986	.757464	.033966	237.762	.0023142	16.1994	13.9190	.7572	14.6762	22.250	37.412	59.662	.044084	.071594	.115678	60.67	.11638	92.6
92.7	1.54689	39.29102	.759808	.034077	238.539	.0023209	16.2463	13.9215	.7599	14.6814	22.274	37.535	59.809	.044128	.071818	.115946	60.77	.11656	92.7
92.8	1.55166	39.41218	.762152	.034188	239.316	.0023276	16.2932	13.9240	.7626	14.6866	22.298	37.658	59.956	.044172	.072042	.116214	60.87	.11674	92.8
92.9	1.55643	39.53334	.764496	.034299	240.093	.0023343	16.3401	13.9265	.7653	14.6918	22.322	37.781	60.103	.044216	.072266	.116482	60.97	.11692	92.9
93.0	1.5612	39.6545	0.76684	0.03441	240.87	0.002341	16.387	13.929	0.768	14.697	22.346	37.904	60.25	0.044260	0.072490	0.116750	61.07	0.1171	93.0
93.1	1.56610	39.77896	.769247	.034525	241.675	.0023480	16.436	13.9315	.7707	14.7022	22.3701	38.0319	60.402	.044303	.072721	.117024	61.17	.11727	93.1
93.2	1.57100	39.90342	.771654	.034640	242.480	.0023550	16.485	13.9340	.7734	14.7074	22.3942	38.1598	60.554	.044346	.072952	.117298	61.27	.11744	93.2
93.3	1.57590	40.02788	.774061	.034755	243.285	.0023620	16.534	13.9365	.7761	14.7126	22.4183	38.2877	60.706	.044389	.073183	.117572	61.37	.11761	93.3
93.4	1.58080	40.15234	.776468	.034870	244.090	.0023690	16.583	13.9390	.7788	14.7178	22.4424	38.4156	60.858	.044432	.073444	.117846	61.47	.11778	93.4
93.5	1.58570	40.27680	0.778815	0.034985	244.895	0.0023760	16.632	13.9415	0.7815	14.7230	22.4665	38.5435	61.010	0.044475	0.073645	0.118120	61.57	0.11795	93.5
93.6	1.59060	40.40126	.781282	.035100	245.700	.002387	16.681	13.9440	.7842	14.7282	22.4906	38.6714	61.162	.044518	.073876	.118394	61.67	.11812	93.6
93.7	1.59550	40.52572	.783689	.035215	246.505	.0023900	16.730	13.9465	.7869	14.7334	22.5147	38.7993	61.314	.044561	.074107	.118668	61.77	.11829	93.7
93.8	1.60040	40.65018	.786096	.035330	247.310	.0023970	16.779	13.9490	.7896	14.7386	22.5388	38.9272	61.466	.044604	.074338	.118942	61.87	.11846	93.8
93.9	1.60530	40.77464	.788503	.035445	248.115	.0024040	16.828	13.9515	.7923	14.7438	22.5629	39.0551	61.618	.044647	.074569	.119216	61.97	.11863	93.9
94.0	1.6102	40.8991	0.79091	0.03556	248.92	0.002411	16.877	13.954	0.795	14.749	22.587	39.183	61.77	0.044690	0.074800	0.119490	62.07	0.1188	94.0
94.1	1.61524	41.02713	.793383	.035677	249.739	.0024181	16.9267	13.9566	.7977	14.7543	22.611	39.314	61.925	.044734	.075038	.119772	62.17	.11898	94.1
94.2	1.62028	41.15516	.795856	.035794	250.558	.0024252	16.9764	13.9592	.8004	14.7596	22.635	39.445	62.080	.044778	.075276	.120054	62.27	.11916	94.2
94.3	1.62532	41.28319	.798329	.035791	251.377	.0024323	17.0261	13.9618	.8031	14.7649	22.659	39.576	62.235	.044822	.075514	.120336	62.37	.11934	94.3
94.4	1.63036	41.41122	.800802	.036028	252.196	.0024394	17.0758	13.9644	.8058	14.7702	22.683	39.707	62.390	.044866	.075752	.120618	62.47	.11952	94.4

94.5	1.63540	41.53925	0.803275	0.036145	253.015	0.0024465	17.1265	13.9670	0.8085	14.7755	22.307	39.838	62.545	0.044910	0.075990	0.120900	62.57	0.11970	94.5
94.6	1.64044	41.66728	.805748	.036262	253.834	.0024536	17.1752	13.9696	.8112	14.7808	22.731	39.969	62.700	.044954	.076228	.121182	62.67	.11988	94.6
94.7	1.64548	41.79531	.808221	.036379	254.653	.0024607	17.2249	13.9722	.8139	14.7861	22.755	40.100	62.855	.044998	.076466	.121464	62.77	.12006	94.7
94.8	1.65052	41.92334	.810694	.036496	255.472	.0024678	17.2746	13.9748	.8166	14.7914	22.779	40.231	63.010	.045042	.076704	.121746	62.87	.12024	94.8
94.9	1.65556	42.05137	.813167	.036613	256.291	.0024749	17.3243	13.9774	.8193	14.7967	22.803	40.362	63.165	.045086	.076942	.122028	62.97	.12042	94.9
95.0	1.6606	42.1794	0.81564	0.03673	257.11	0.002482	17.374	13.980	0.822	14.802	22.827	40.493	63.32	0.04513	0.07718	0.12231	63.07	0.1206	95.0
95.1	1.66577	42.31070	.818179	.036852	257.964	.0024893	17.4251	13.9825	.8249	14.8074	22.8511	40.6289	63.48	.045173	.077425	.122598	63.169	.12078	95.1
95.2	1.67094	42.44200	.820718	.036974	258.818	.0024966	17.4762	13.9850	.8278	14.8128	22.8752	40.7648	63.64	.045216	.077670	.122886	63.268	.12096	95.2
95.3	1.67611	42.57330	.823257	.037096	259.672	.0025039	17.5273	13.9875	.8307	14.8182	22.8993	40.9007	63.80	.045259	.077915	.123174	63.367	.12114	95.3
95.4	1.68128	42.70460	.825796	.037218	260.526	.0025112	17.5784	13.9900	.8336	14.8236	22.9234	41.0366	63.96	.045302	.078160	.123462	63.466	.12132	95.4
95.5	1.68645	42.83590	0.828335	0.037340	261.380	0.0025185	17.6295	13.9925	0.8365	14.8290	22.9475	41.1725	64.12	0.045345	0.078405	0.123750	63.565	0.12150	95.5
95.6	1.69162	42.96720	.830874	.037462	262.234	.0025258	17.6806	13.9950	.8394	14.8344	22.9716	41.3084	64.28	.045388	.078650	.124038	63.664	.12168	95.6
95.7	1.69679	43.09850	.833413	.037584	263.088	.0025331	17.7317	13.9975	.8423	14.8398	22.9957	41.4443	64.44	.045431	.078895	.124326	63.763	.12186	95.7
95.8	1.70196	43.22980	.835952	.037706	263.942	.0025404	17.7828	14.0000	.8452	14.8452	23.0198	41.5802	64.60	.045474	.079140	.124614	63.862	.12204	95.8
95.9	1.70713	43.36110	.838491	.037828	264.796	.0025477	17.8339	14.0025	.8481	14.8506	23.0439	41.7161	64.76	.045517	.079385	.124902	63.961	.12222	95.9
96.0	1.7123	43.4924	0.84103	0.03795	265.65	0.002555	17.885	14.005	0.851	14.856	23.068	41.852	64.92	0.045560	0.07963	0.125190	64.06	0.1224	96.0
96.1	1.71761	43.62728	.843638	.038075	266.525	.0025624	17.9368	14.0075	.854	14.8615	23.092	41.991	65.083	.045604	.079882	.125486	64.16	.12258	96.1
96.2	1.72292	43.76216	.846246	.038200	267.400	.0025698	17.9886	14.0100	.857	14.8670	23.116	42.130	65.246	.045648	.080134	.125782	64.26	.12276	96.2
96.3	1.72823	43.89704	.848854	.038325	268.275	.0025772	18.0404	14.0125	.860	14.8725	23.140	42.269	65.409	.045692	.080386	.126078	64.36	.12294	96.3
96.4	1.73354	44.03192	.851462	.038450	269.150	.0025846	18.0922	14.0150	.863	14.8780	23.164	42.408	65.572	.045736	.080638	.126374	64.46	.12312	96.4
96.5	1.73885	44.16680	0.854070	0.038575	270.025	0.0025920	18.1440	14.0175	0.866	14.8835	23.188	42.547	65.735	0.045780	0.080890	0.126670	64.56	0.12330	96.5
96.6	1.74416	44.30168	.856678	.038700	270.900	.0025994	18.1958	14.0200	.869	14.8890	23.212	42.686	65.898	.045824	.081142	.126966	64.66	.12348	96.6
96.7	1.74947	44.43656	.859286	.038825	271.775	.0026068	18.2476	14.0225	.872	14.8945	23.236	42.824	66.061	.045868	.081394	.127262	64.76	.12366	96.7
96.8	1.75478	44.57144	.861894	.038950	272.650	.0026142	18.2994	14.0250	.875	14.9000	23.260	42.964	66.224	.045912	.081646	.127558	64.86	.12384	96.8
96.9	1.76009	44.70632	.864502	.039075	273.525	.0026216	18.3512	14.0275	.878	14.9055	23.284	43.103	66.387	.045956	.081898	.127854	64.96	.12402	96.9
97.0	1.7654	44.8412	0.86711	0.039320	274.40	0.002629	18.403	14.030	0.881	14.911	23.308	43.242	66.55	0.046000	0.082150	0.12815	65.06	0.1242	97.0
97.1	1.77085	44.97963	.869787	.039329	275.303	.0026366	18.4562	14.0326	.884	14.9166	23.332	43.386	66.718	.046043	.082409	.128452	65.16	.12438	97.1
97.2	1.77630	45.11806	.872464	.039458	276.206	.0026442	18.5094	14.0352	.887	14.9222	23.356	43.530	66.886	.046086	.082668	.128754	65.26	.12456	97.2
97.3	1.78175	45.25649	.875141	.039587	277.109	.0026518	18.5626	14.0378	.890	14.9278	23.380	43.674	67.054	.046129	.082927	.129056	65.36	.12474	97.3
97.4	1.78720	45.39492	.877818	.039716	278.012	.0026594	18.6158	14.0404	.893	14.9334	23.404	43.818	67.222	.046172	.083186	.129358	65.46	.12492	97.4
97.5	1.79265	45.5335	0.880495	0.039845	278.915	0.0026670	18.6690	14.0430	0.896	14.9390	23.428	43.962	67.390	0.046215	0.083445	0.129660	65.56	0.12510	97.5
97.6	1.79810	45.67178	.883172	.039974	279.818	.0026746	18.7222	14.0456	.899	14.9446	23.452	44.106	67.558	.046258	.083704	.129962	65.66	.12528	97.6
97.7	1.80355	45.81021	.885849	.040103	280.721	.0026822	18.7754	14.0482	.902	14.9502	23.476	44.250	67.726	.046361	.083963	.130264	65.76	.12546	97.7
97.8	1.80900	45.94864	.888526	.040232	281.624	.0026898	18.8286	14.0508	.905	14.9558	23.500	44.394	67.894	.046344	.084222	.130566	65.86	.12564	97.8
97.9	1.81445	46.08707	.891203	.040361	282.527	.0026974	18.8818	14.0534	.908	14.9614	23.524	44.538	68.062	.046387	.084481	.130868	65.96	.12582	97.9
98.0	1.8199	46.2255	0.89388	0.040490	283.43	0.002705	18.935	14.056	0.911	14.967	23.548	44.682	68.23	0.046430	0.084740	0.131170	66.06	0.12600	98.0
98.1	1.82550	46.36774	.896629	.040623	284.361	.0027129	18.9903	14.0585	.9141	14.9726	23.5721	44.8309	68.403	.046473	.085007	.131480	66.16	.12618	98.1
98.2	1.83110	46.50998	.899378	.040756	285.292	.0027208	19.0456	14.0610	.9172	14.9782	23.5962	44.9798	68.576	.046516	.085274	.13179	66.26	.12636	98.2
98.3	1.83670	46.65222	.902127	.040889	286.223	.0027287	19.1009	14.0635	.9203	14.9838	23.6203	45.1287	68.749	.046559	.085541	.13210	66.36	.12654	98.3
98.4	1.84230	46.79446	.904876	.041022	287.154	.0027366	19.1562	14.0660	.9234	14.9894	23.6444	45.2776	68.922	.046602	.085808	.13241	66.46	.12672	98.4
98.5	1.84790	46.93670	0.907625	0.041155	288.085	0.0027445	19.2115	14.0685	0.9265	14.9950	23.6685	45.4265	69.095	0.046645	0.086075	0.13272	66.56	0.12690	98.5
98.6	1.85350	47.07894	.910374	.041288	289.046	.0027524	19.2668	14.0710	.9296	15.0006	23.6926	45.5754	69.268	.046688	.086342	.13303	66.66	.12708	98.6
98.7	1.85910	47.22118	.913123	.041421	289.947	.0027603	19.3221	14.0735	.9327	15.0062	23.7167	45.7243	69.441	.046731	.086609	.13334	66.76	.12726	98.7
98.8	1.86470	47.36342	.915872	.041554	290.878	.0027682	19.3774	14.0760	.9358	15.0118	23.7408	45.8732	69.614	.046774	.086876	.13365	66.86	.12744	98.8
98.9	1.87030	47.50566	.918621	.041687	291.809	.0027761	19.4327	14.0785	.9389	15.0174	23.7649	46.0221	69.787	.046817	.087143	.13396	66.96	.12762	98.9

99.0	1.8759	47.6479	0.92137	0.04182	292.74	0.002784	19.4888	14.081	.942	15.023	23.789	46.171	69.96	0.046860	0.087410	0.13427	67.06	0.12780	99.0
99.1	1.88164	47.79369	.924192	.041957	293.699	.002792	19.5440	14.0835	.9453	15.0288	23.813	46.3240	70.137	.046903	.087685	.134588	67.16	.12798	99.1
99.2	1.88738	47.93948	.927014	.042094	294.658	.002800	19.6000	14.0860	.9486	15.0346	23.837	46.477	70.314	.046946	.087860	.134906	67.26	.12816	99.2
99.3	1.89312	48.08527	.929836	.042231	295.617	.002808	19.6560	14.0885	.9519	15.0404	23.861	46.630	70.491	.046989	.088235	.135224	67.36	.12834	99.3
99.4	1.89886	48.23106	.932658	.042368	296.576	.002816	19.7120	14.0910	.9552	15.0462	23.885	46.783	70.668	.047032	.088510	.135542	67.46	.12852	99.4
99.5	1.90460	48.37685	0.935480	0.042505	297.535	0.002824	19.7680	14.0935	.9585	15.0520	23.909	46.936	70.845	0.047075	0.088785	0.135860	67.56	0.12870	99.5
99.6	1.91034	48.52264	.938302	.042642	298.494	.002832	19.8240	14.0960	.9618	15.0578	23.933	47.089	71.022	.047118	.089060	.136178	67.66	.12888	99.6
99.7	1.91608	48.66843	.941124	.042799	299.453	.002840	19.8800	14.0985	.9651	15.0636	23.957	47.242	71.199	.047161	.089335	.136496	67.76	.12906	99.7
99.8	1.92182	48.81422	.943946	.042916	300.412	.002848	19.9360	14.1010	.9684	15.0694	23.981	47.395	71.376	.047204	.089610	.136814	67.86	.12924	99.8
99.9	1.92756	48.96001	.946786	.043053	301.371	.002856	19.9920	14.1035	.9717	15.0752	24.005	47.548	71.553	.047247	.089885	.137132	67.96	.12942	99.9
100.0	1.9333	49.1058	0.94959	0.04319	302.33	0.002864	20.0480	14.106	.975	15.081	24.029	47.701	71.73	0.047290	0.090160	0.13750	68.06	0.12960	100.0
100.1	1.93920	49.25566	.952485	.043331	303.317	.0028722	20.1054	14.1085	.9784	15.0869	24.0531	47.8589	71.912	.047333	.090443	.137776	68.159	.12978	100.1
100.2	1.93451	49.40552	.955380	.043472	304.304	.0028804	20.1628	14.1110	.9818	15.0928	24.0772	48.0168	72.094	.047376	.090726	.138102	68.258	.12996	100.2
100.3	1.95100	49.55538	.958275	.043613	305.291	.0028886	20.2202	14.1135	.9852	15.0987	24.1013	48.1747	72.276	.047419	.091009	.138428	68.357	.13014	100.3
100.4	1.95690	49.70524	.961170	.043754	306.278	.0028968	20.2776	14.1160	.9886	15.1046	24.1254	48.3326	72.458	.047462	.091292	.138754	68.456	.13032	100.4
100.5	1.96280	49.85510	0.964065	0.043895	307.265	0.0029050	20.3350	14.1185	.9920	15.1105	24.1495	48.4905	72.640	0.047505	0.091575	0.139080	68.555	0.13050	100.5
100.6	1.96870	50.00496	.966960	.044036	308.252	.0029132	20.3924	14.1210	.9954	15.1164	24.1736	48.6484	72.822	.047548	.091858	.139406	68.654	.13068	100.6
100.7	1.97460	50.15482	.969855	.044177	309.239	.0029214	20.4498	14.1235	.9988	15.1223	24.1977	48.8063	73.004	.047591	.092141	.139732	68.753	.13086	100.7
100.8	1.98050	50.30468	.972750	.044318	310.226	.0029296	20.5072	14.1260	1.0022	15.1282	24.2218	48.9642	73.186	.047634	.092424	.140058	68.852	.13104	100.8
100.9	1.98640	50.45454	.975645	.044459	311.213	.0029378	20.5646	14.1285	1.0056	15.1341	24.2459	49.1221	73.368	.047677	.092707	.140384	68.951	.13122	100.9
101.0	1.9923	50.6044	0.97854	0.04460	312.20	0.002946	20.622	14.131	1.009	15.140	24.270	49.28	73.55	0.04772	0.09299	0.14071	69.05	0.1314	101.0
101.1	1.99835	50.75807	.981516	.044746	313.222	.0029544	20.6808	14.1336	1.0124	15.146	24.294	49.443	73.737	.047763	.093282	.141045	69.15	.13158	101.1
101.2	2.00440	50.91174	.984492	.044892	314.244	.0029628	20.7396	14.1362	1.0158	15.152	24.318	49.606	73.924	.047806	.093574	.14138	69.25	.13176	101.2
101.3	2.001045	51.06541	.987468	.045038	315.266	.0029712	20.7984	14.1388	1.0192	15.158	24.342	49.769	74.111	.047849	.093866	.141715	69.35	.13194	101.3
101.4	2.01650	51.21908	.990444	.045184	316.288	.0029796	20.8572	14.1414	1.0226	15.164	24.366	49.932	74.298	.047892	.094158	.14205	69.45	.13212	101.4
101.5	2.02255	51.37275	0.993420	0.045330	317.310	0.0029880	20.9160	14.1440	1.0260	15.170	24.390	50.095	74.485	0.047935	0.094450	0.142385	69.55	0.13230	101.5
101.6	2.02860	51.52642	.996396	.045476	318.332	.0029964	20.9748	14.1466	1.0294	15.176	24.414	50.258	74.672	.047978	.094742	.142720	69.65	.13248	101.6
101.7	2.03465	51.68009	.999372	.045622	319.354	.0030048	21.0336	14.1492	1.0328	15.182	24.438	50.421	74.859	.048021	.095034	.143055	69.75	.13266	101.7
101.8	2.04070	51.83376	1.002348	.045768	320.376	.0030132	21.0924	14.1518	1.0362	15.188	24.462	50.584	75.046	.048064	.095326	.14339	69.85	.13284	101.8
101.9	2.04675	51.98743	1.005324	.045914	321.398	.0030216	21.1512	14.1544	1.0396	15.194	24.486	50.747	75.233	.048107	.095618	.143725	69.95	.13302	101.9
102.0	2.0528	52.1411	1.00830	0.04606	322.42	0.003030	21.21	14.157	1.043	15.200	24.510	50.91	75.42	0.048150	0.09591.0	0.14406	70.05	0.1332	102.0
102.1	2.05901	52.29884	1.01135	.046210	323.47	.0030386	21.2702	14.1595	1.0466	15.2061	24.5341	51.0779	75612	.048193	.09621	.144403	70.15	.13338	102.1
102.2	2.06522	52.45658	1.01440	.046360	324.52	.0030472	21.3304	14.1620	1.0502	15.2122	24.5582	51.2458	75804	.048236	.09651	.144746	70.25	.13356	102.2
102.3	2.07143	52.61432	1.01745	.046510	325.57	.0030558	21.3906	14.1645	1.0538	15.2183	24.5823	51.4137	75996	.048279	.09681	.145089	70.35	.13374	102.3
102.4	2.07764	52.77206	1.02050	.046660	326.62	.0030644	21.4508	14.1670	1.0574	15.2244	24.6064	51.5816	76.188	.048322	.09711	.145432	70.45	.13392	102.4
102.5	2.08385	52.92980	1.02355	0.046810	327.67	0.0030730	21.511	14.1695	1.0610	15.2305	24.6305	51.7495	76.38	0.048365	0.09741	0.145775	70.55	0.13410	102.5
102.6	2.09006	53.08754	1.02660	.046960	328.72	.0030816	21.5712	14.1720	1.0646	15.2366	24.6546	51.9174	76.572	.048408	.09771	.146118	70.65	.13428	102.6
102.7	2.09627	53.24524	1.02965	.04711	329.77	.0030902	21.6314	14.1745	1.0682	15.2427	24.6787	52.0853	76.764	.048451	.09801	.146461	70.75	.13446	102.7
102.8	2.10248	53.40302	1.03270	.047260	330.82	.0030988	21.6916	14.1770	1.0718	15.2488	24.7028	52.2532	76.956	.048494	.09831	.146804	70.85	.13464	102.8
102.9	2.10869	53.56076	1.03575	.047410	331.87	.0031074	21.7518	14.1795	1.0754	15.2545	24.7269	52.4211	77.148	.048537	.09861	.147147	70.95	.13482	102.9
103.0	2.1149	53.7185	1.0388	0.04756	332.92	0.003116	21.812	14.182	1.079	15.261	24.751	52.589	77.34	0.048580	0.09891	0.14749	71.05	0.13500	103.0
103.1	2.12127	53.88029	1.04192	.047715	334.005	.0031249	21.8743	14.1845	1.0828	15.2673	24.775	52.762	77.537	.048622	.099219	.147841	71.15	.13517	103.1
103.2	2.12764	54.04208	1.04504	.047870	335.090	.0031338	21.9366	14.1870	1.0866	15.2736	24.799	52.935	77.734	.048664	.099428	.148192	71.25	.13534	103.2
103.3	2.13401	54.20387	1.04816	.048025	336.175	.0031427	21.9989	14.1895	1.0904	15.2799	24.823	53.108	77.931	.048706	.099837	.148543	71.35	.13551	103.3
103.4	2.14038	54.36566	1.05128	.048180	337.260	.0031516	22.0612	14.1920	1.0942	15.2862	24.847	53.281	78.128	.048748	.100146	.148894	71.45	.13568	103.4

103.5	2.14675	54.52745	1.05440	0.048335	338.345	0.0031605	22.1235	14.1945	1.0980	15.2925	24.871	53.454	78.325	0.048790	0.100455	0.149245	71.55	0.13588	103.5
103.6	2.15312	54.68924	1.05752	.048490	339.430	.0031694	22.1858	14.1970	1.1018	15.2988	24.895	53.629	78.522	.048832	.100764	.149596	71.65	.13602	103.6
103.7	2.15949	54.85103	1.06064	.048645	340.515	.0031783	22.2481	14.1995	1.1056	15.3051	24.919	53.800	78.719	.048874	.101073	.149947	71.75	.13619	103.7
103.8	2.16586	55.01282	1.06376	.04880	341.600	.0031872	22.3104	14.2020	1.1094	15.3114	24.943	53.973	78.916	.048916	.101382	.150298	71.85	.13636	103.8
103.9	2.17223	55.17461	1.06688	.048955	342.685	.0031961	22.3727	14.2045	1.1132	15.3177	24.967	54.146	79.113	.048958	.101691	.150649	71.95	.13653	103.9
104.0	2.1786	55.3364	1.0700	0.04911	343.77	0.003205	22.435	14.207	1.117	15.324	24.991	54.319	79.31	0.049000	0.10200	0.151000	72.05	0.1367	104.0
104.1	2.18513	55.50227	1.07321	.049269	344.883	.003214	22.498	14.2095	1.1208	15.3303	25.0151	54.4979	79.513	.049043	.10232	.151363	72.149	.13688	104.1
104.2	2.19166	55.66814	1.07642	.049428	345.996	.003223	22.561	14.2120	1.1246	15.3366	25.0392	54.6768	79.716	.049086	.10264	.151726	72.248	.13706	104.2
104.3	2.19819	55.83401	1.07963	.049587	347.109	.003232	22.624	14.2145	1.1284	15.3429	25.0633	54.8557	79.919	.049129	.10296	.152089	72.347	.13724	104.3
104.4	2.20472	55.99988	1.08284	.049746	348.222	.003241	22.687	14.2170	1.1322	15.3492	25.0874	55.0346	80.122	.049172	.10328	.152452	72.446	.13742	104.4
104.5	2.21125	56.16575	1.08605	0.049905	349.335	0.003250	22.75	14.2195	1.1360	15.3555	25.1115	55.2135	80.325	0.049215	0.10360	0.152815	72.545	0.13760	104.5
104.6	2.21778	56.33162	1.08926	.050064	350.448	.003259	22.813	14.2220	1.1398	15.3618	25.1356	55.3924	80.528	.049258	.10392	.153178	72.644	.13778	104.6
104.7	2.22431	56.49749	1.09247	.050223	351.561	.003268	22.876	14.2245	1.1436	15.3681	25.1597	55.5713	80.731	.049301	.10424	.153541	72.743	.13796	104.7
104.8	2.23084	56.66336	1.09568	.050882	352.674	.003277	22.939	14.2270	1.1474	15.3744	25.1838	55.7502	80.934	.049344	.10456	.153904	72.842	.13814	104.8
104.9	2.23737	56.82923	1.09889	.050541	353.787	.003286	23.002	14.2295	1.1512	15.3807	25.2079	55.9291	81.137	.049387	.10488	.154267	72.941	.13832	104.9
105.0	2.2439	56.9951	1.10210	0.05070	354.90	0.003295	23.065	14.232	1.155	15.387	25.232	56.108	81.34	0.049430	0.1052	0.15463	73.04	0.13850	105.0
105.1	2.25060	57.16528	1.1054	.050864	356.048	.0033042	23.1294	14.2346	1.1589	15.3935	25.256	56.292	81.548	.049472	.10553	.155002	73.14	.13868	105.1
105.2	2.25730	57.33546	1.1087	.051028	357.196	.0033134	23.1938	14.2372	1.1628	15.4000	25.280	56.476	81.756	.049514	.10586	.155374	73.24	.13886	105.2
105.3	2.26400	57.50564	1.1120	.051192	358.344	.0033226	23.2582	14.2398	1.1667	15.4065	25.304	56.660	81.964	.049556	.10619	.155746	73.34	.13904	105.3
105.4	2.27070	57.67582	1.1153	.051356	359.492	.0033318	23.3226	14.2424	1.1706	15.4130	25.328	56.844	82.172	.049598	.10652	.156118	73.44	.13922	105.4
105.5	2.27740	57.84600	1.1186	0.051520	360.640	0.0033410	23.3870	14.2450	1.1745	15.4195	25.352	57.028	82.380	0.049640	0.10685	0.156490	73.54	0.13940	105.5
105.6	2.28410	58.01618	1.1219	.051684	361.788	.0033502	23.4514	14.2476	1.1784	15.4260	25.376	57.212	82.588	.049682	.10718	.156862	73.64	.13958	105.6
105.7	2.29080	58.18636	1.1252	.051848	362.936	.0033594	23.5158	14.2502	1.1823	15.4325	25.400	57.396	82.796	.049724	.10751	.157234	73.74	.13976	105.7
105.8	2.29750	58.35654	1.1285	.052012	364.084	.0033686	23.5802	14.2528	1.1862	15.4390	25.424	57.580	83.004	.049766	.10784	.157606	73.84	.13994	105.8
105.9	2.30420	58.52672	1.1318	.052176	365.232	.0033778	23.6446	14.2554	1.1901	15.4455	25.448	57.764	83.212	.049808	.10817	.157978	73.94	.14012	105.9
106.0	2.3109	58.6969	1.1351	0.05234	366.38	0.003387	23.709	14.258	1.194	15.452	25.472	57.948	83.42	0.049850	0.1085	0.158350	74.04	0.14030	106.0
106.1	2.31778	58.87165	1.13857	.052510	367.570	.0033965	23.7755	14.2605	1.1981	15.4586	25.4961	58.1379	83.634	.049893	.10883	.158723	74.14	.14048	106.1
106.2	2.32466	59.04640	1.14204	.052680	368.760	.0034060	23.8420	14.2630	1.2022	15.4652	25.5202	58.3278	83.848	.049936	.10916	.159096	74.24	.14066	106.2
106.3	2.33154	59.22115	1.14551	.052850	369.950	.0034155	23.9085	14.2655	1.2063	15.4718	25.5443	58.5177	84.062	.049979	.10949	.159469	74.34	.14084	106.3
106.4	2.33842	59.39590	1.14898	.053020	371.14	.0034250	23.9750	14.2680	1.2104	15.4784	25.5684	58.7076	84.276	.050022	.10982	.159842	74.44	.14102	106.4
106.5	2.34530	59.57065	1.15245	0.053190	372.330	0.003435	24.0415	14.2705	1.2145	15.4850	25.5925	58.8975	84.490	0.050065	0.11015	0.160215	74.54	0.14120	106.5
106.6	2.35218	59.74540	1.15592	.053360	373.52	.003444	24.1080	14.2730	1.2186	15.4916	25.6166	59.0874	84.704	.050108	.11048	.160588	74.64	.14138	106.6
106.7	2.35906	59.92015	1.15939	.053530	374.71	.003453	24.1745	14.2755	1.227	15.4982	25.6407	59.2773	84.918	.050151	.11081	.160961	74.74	.14156	106.7
106.8	2.36594	60.09490	1.16286	.05370	375.90	.0034630	24.2410	14.2780	1.2268	15.5048	25.6648	59.4672	85.132	.050194	.11114	.161334	74.84	.14174	106.8
106.9	2.37282	60.26965	1.16636	.053870	377.09	.0034725	24.3075	14.2805	1.2309	15.5114	25.6889	59.6571	85.346	.050237	.11147	.161707	74.94	.14192	106.9
107.0	2.3797	60.4444	1.1688	0.05404	378.28	0.003482	24.374	14.283	1.235	15.518	25.713	59.847	85.56	0.05028	0.1118	0.16208	75.04	0.1421	107.0
107.1	2.38675	60.62347	1.17227	.054214	379.498	.0034917	24.4419	14.2855	1.2393	15.5248	25.7370	60.0430	85.78	.050322	.11215	.162472	75.14	.14227	107.1
107.2	2.39380	60.80254	1.17574	.054388	380.716	.0035014	24.5098	14.2880	1.2436	15.5316	25.7610	60.2390	86.00	.050364	.11250	.162864	75.24	.14244	107.2
107.3	2.40085	60.98161	1.17921	.054562	381.934	.0035111	24.5777	14.2905	1.2479	15.5384	25.785	60.435	86.22	.050406	.11285	.163256	75.34	.14261	107.3
107.4	2.40790	61.16068	1.18268	.054736	383.152	.0035208	24.6456	14.2930	1.2522	15.5452	25.809	60.631	86.44	.050448	.11320	.163648	75.44	.14278	107.4
107.5	2.41495	61.33975	1.18615	0.054910	384.370	0.0035305	24.7135	14.2955	1.2565	15.5520	25.833	60.827	86.66	0.050490	0.11355	0.164040	75.54	0.14295	107.5
107.6	2.42200	61.57882	1.18962	.055084	385.588	.0035402	24.7814	14.2980	1.2608	15.5588	25.857	61.023	86.88	.050532	.11390	.164432	75.64	.14312	107.6
107.7	2.42905	61.69789	1.19309	.055258	386.806	.0035499	24.8493	14.3005	1.2651	15.5656	25.881	61.219	86.71	.050574	.11425	.164824	75.74	.14329	107.7
107.8	2.43610	61.87696	1.19656	.055432	388.024	.0035596	24.9172	14.3030	1.2694	15.5724	25.905	61.415	87.32	.050616	.11460	.165216	75.84	.14346	107.8
107.9	2.44315	62.05603	1.20003	.055606	389.242	.0035693	24.9851	14.3055	1.2737	15.5792	25.929	61.611	87.54	.050658	.11495	.165608	75.94	.14363	107.9

108.0	2.4502	62.2351	1.2035	0.05578	390.46	0.003579	25.053	14.308	1.278	15.586	25.953	61.807	87.76	0.05070	0.1153	0.16600	76.04	0.1438	108.0
108.1	2.45743	62.41874	1.20705	.055961	391.727	.003589	25.123	14.3105	1.2823	15.5928	25.9771	62.0099	87.987	.050743	.11566	.166403	76.14	.14398	108.1
108.2	2.46466	62.60238	1.21060	.056142	392.994	.003599	25.193	14.3130	1.2866	15.5996	26.0012	62.2128	88.214	.050786	.11602	.166806	76.24	.14416	108.2
108.3	2.47189	62.78602	1.21415	.056323	394.261	.003609	25.263	14.3155	1.2909	15.6064	26.0253	62.4157	88.441	.050829	.11638	.167209	76.34	.14434	108.3
108.4	2.47912	62.96966	1.21770	.056504	395.528	.003619	25.333	14.3180	1.2952	15.6132	26.0494	62.6186	88.668	.050872	.11674	.167612	76.44	.14452	108.4
108.5	2.48635	63.15330	1.22125	0.056685	396.795	0.003629	25.403	14.3205	1.2995	15.600	26.0735	62.8215	88.895	0.050915	0.11710	0.168015	76.54	0.14470	108.5
108.6	2.49358	63.33694	1.22480	.056866	398.062	.003639	25.473	14.3230	1.3038	15.6268	26.0976	63.0244	89.122	.050958	.11746	.168418	76.64	.14488	108.6
108.7	2.50081	63.52058	1.22835	.057047	399.329	.003649	25.543	14.3255	1.3081	15.6336	26.1217	63.2273	89.349	.051001	.11782	.168821	76.74	.14506	108.7
108.8	2.50804	63.70422	1.23190	.057228	400.596	.003659	25.613	14.3280	1.3124	15.6404	26.1458	63.4302	89.576	.051044	.11818	.169224	7684	.14524	108.8
108.9	2.51527	63.88786	1.23545	.057409	401.863	.003669	25.683	14.3305	1.3167	15.6472	26.1699	63.6331	89.803	.051087	.11854	.169647	76.94	.14543	108.9
109.0	2.5225	64.0714	1.2390	0.05759	403.13	0.003679	25.753	14.338	1.321	15.654	26.194	63.836	90.03	0.051130	0.1189	0.1700	77.04	0.1456	109.0
109.1	2.52991	64.25671	1.24264	.057775	404.425	.003689 1	25.8237	14.3356	1.3254	15.6610	26.218	64.043	90.267	.051172	.11927	.170442	77.139	.14576	109.1
109.2	2.53732	64.44192	1.24628	.057960	405.720	.003699 2	25.8944	14.3382	1.3298	15.6680	26.242	64.250	90.492	.051214	.11964	.170854	77.238	.14592	109.2
109.3	2.54473	64.62713	1.24992	.058145	407.015	.003709 3	25.9651	14.3408	1.3342	15.6750	26.266	64.457	90.723	.051256	.12001	.171266	77.337	.14608	109.3
109.4	2.55214	64.81234	1.25356	.058330	408.310	.003719 4	26.0358	14.3434	1.3386	15.6820	26.290	64.664	90.954	.051298	.12038	.171678	77.436	.14624	109.4
109.5	2.55955	64.99755	1.25720	0.058515	409.605	0.003729 5	26.1065	14.3460	1.3430	15.6890	26.314	64.871	91.185	0.051340	0.12075	0.172090	77.535	0.14640	109.5
109.6	2.56696	65.18276	1.26084	.058700	410.900	.003739 6	26.1772	14.3486	1.3474	15.6960	26.338	65.078	91.416	.051382	.12112	.172502	77.634	.14656	109.6
109.7	2.57437	65.36797	1.26448	.058885	412.195	.003749 7	26.2479	14.3512	1.3518	15.7030	26.362	65.285	91.647	.051424	.12149	.172914	77.733	.14672	109.7
109.8	2.58178	65.55318	1.26812	.059070	413.490	.003759 8	26.3186	14.3538	1.3562	15.710	26.386	65.492	91.878	.051466	.12186	.173326	77.832	.14688	109.8
109.9	2.58919	65.73839	1.27176	.059255	414.785	.003769 9	26.3893	14.3564	1.3606	15.7170	26.440	65.699	92.109	.051508	.12223	.173738	77.931	.14704	109.9
110.0	2.5966	65.9236	1.2754	0.05944	416.08	0.003780	26.460	14.359	1.365	15.724	26.434	65.906	92.34	0.051555	0.12266	0.17415	78.03	0.1472	110.0
110.1	2.60420	66.11964	1.27914	.059631	417.417	.003790 4	26.5328	14.3615	1.3697	15.7312	26.4581	66.1199	92.578	.051592	.12298	.174672	78.13	.14739	110.1
110.2	2.61180	66.31568	1.28288	.059822	418.754	.003800 8	26.6056	14.3640	1.3744	15.7384	26.4822	66.3338	92.816	.051634	.12336	.174994	78.23	.14758	110.2
110.3	2.61940	66.51172	1.28662	.060013	420.091	.003811 2	26.6784	14.3665	1.3791	15.7456	26.5063	66.5417	93.054	.051676	.12374	.175416	78.33	.14777	110.3
110.4	2.62700	66.70776	1.29036	.060204	421.428	.003821 6	26.7512	14.3690	1.3838	15.7528	26.5304	66.7616	93.292	.051718	.12412	.175838	78.43	.14796	110.4
110.5	2.63460	66.90380	1.29410	0.060395	422.765	0.003832 0	26.8240	14.3715	1.3885	15.7600	26.5545	66.9755	93.530	0.051760	0.12450	0.176260	78.53	0.14815	110.5
110.6	2.64220	67.09984	1.29784	.060586	424.102	.003842 4	26.8968	14.3740	1.3932	15.7672	26.5786	67.1894	93.768	.051802	.12488	.176682	78.63	.14834	110.6
110.7	2.64980	67.29588	1.30158	.060770	425.439	.003852 8	26.9696	14.3765	1.3979	15.7744	26.6027	67.4033	94.006	.051844	.12526	.177104	78.73	.14853	110.7
110.8	2.65740	67.49192	1.30532	.060968	426.776	.003863 2	27.0424	143790	1.4026	15.7816	26.6268	67.6172	94.244	.051886	.12564	.177526	78.83	.14872	110.8
110.9	2.66500	67.68796	1.30906	.061159	428.113	.003873 6	27.1152	14.3815	1.4073	15.7888	26.6509	67.8311	94.482	.051928	.12602	.177948	78.93	.14891	110.9
111.0	2.6726	67.8840	1.3128	0.06135	429.45	0.003884	27.188	14.384	1.412	15.796	26.675	68.045	94.72	0.051970	0.12640	0.178430	79.03	0.14910	111.0
111.1	2.68039	68.08287	1.31662	.061548	430.836	.003894 7	27.2629	14.3865	1.4168	15.8033	26.6990	68.2670	94.966	.052012	.12678	.178792	79.13	.14927	111.1
111.2	2.68818	68.28174	1.32044	.061746	432.222	.003905 4	27.3378	14.3890	1.4216	15.8106	26.7230	68.4890	95.212	.052054	.12716	.179214	79.23	.14944	111.2
111.3	2.69597	68.48061	1.32426	.061944	433.608	.003916 1	27.4127	14.3915	1.4264	15.8179	26.7470	68.711	95.458	.052096	.12754	.179636	79.33	.14961	111.3
111.4	2.70376	68.67948	1.32808	.062142	434.994	.003926 8	27.4876	14.3940	1.4312	15.8252	26.7710	68.933	95.704	.052138	.12792	.180058	7943	.14978	111.4
111.5	2.71155	68.87835	1.33190	0.062340	436.380	0.003937 5	27.5625	143965	1.4360	15.8325	26.7950	69.155	95.950	0.052180	0.12830	0.180480	79.53	0.14995	111.5
111.6	2.71934	69.07722	1.33572	.062538	437.766	.003948 2	27.6374	14.3990	1.4408	15.8398	26.8190	69.377	96.196	.052222	.12868	.180902	7963	.15012	111.6
111.7	2.72713	69.27609	1.33954	.062736	439.152	.003958 9	27.7123	14.4015	1.4456	15.8471	26.8430	69.599	96.442	.052264	12906	.181324	79.73	.15029	111.7
111.8	2.73492	69.47496	1.34336	.062934	440.538	.003969 6	27.7872	14.4040	1.4504	15.8544	26.8670	69.821	96.688	.052306	.12944	.181746	79.83	.15046	111.8
111.9	2.74271	69.67383	1.34718	.063132	441.924	.003980 3	27.8621	14.4065	14552	15.8617	26.8910	70.043	96.934	.052348	.12982	.182168	79.93	.15063	111.9
112.0	2.7505	69.8727	1.3510	0.06333	443.31	0.003991	27.937	14.409	1.460	15.869	26.915	70.265	97.18	0.05239	0.1302	0.18257	80.03	0.1508	112.0
112.1	2.75849	70.07465	1.35492	.063533	444.731	.004001 8	28.0126	14.4116	1.4649	15.8765	26.9391	70.4939	97.433	.052432	.1306	.183032	80.13	.15097	112.1
112.2	2.76648	70.27660	1.35884	.063736	446.152	.004012 6	28.0882	14.4142	1.4698	15.8840	26.9632	70.7228	97.686	.052474	.1310	.183474	80.23	.15114	112.2
112.3	2.77447	70.47853	1.36276	.063939	447.573	.004023 4	28.1638	14.4168	1.4747	15.8915	26.9873	70.9517	97.939	.052516	.1314	.183916	80.33	.15131	112.3
112.4	2.78246	70.68050	1.36668	.064142	448.994	.004034 2	28.2394	14.4194	1.4796	15.8990	27.0114	71.1806	98.192	.052558	.1318	.184358	80.43	.15148	112.4

112.5	2.79048	70.88245	1.37060	0.064345	450.415	0.0040450	28.3150	14.4220	1.4845	15.9065	27.0355	71.4095	98.445	0.052600	0.1372	0.184800	80.53	0.15165	112.5
112.6	2.79844	71.08440	1.37452	.064548	451.836	.0040558	28.39306	14.4246	1.4894	15.9140	27.0596	71.6384	98.658	.052642	.1326	.185242	80.63	.15182	112.6
112.7	2.80643	71.28635	1.37844	.064751	453.257	.0040666	28.4662	14.4272	1.4943	15.9215	27.0837	71.8673	98.951	.052684	.1330	.185684	80.73	.15199	112.7
112.8	2.81442	71.48830	1.38236	.064954	454.678	.0040774	28.5418	14.4298	1.4992	15.9290	27.1078	72.0962	99.204	.052726	.1334	.186126	80.83	.15216	112.8
112.9	2.82241	71.69025	1.38628	.065157	456.099	.0040882	28.6174	14.4324	1.5041	15.9365	27.1319	72.3251	99.457	.052768	.1338	.186568	80.93	.15233	112.9
113.0	2.8304	71.8922	1.3902	0.06536	457.52	0.004099	28.693	14.435	1.509	15.944	27.156	72.554	99.71	0.05281	.1342	0.18701	81.03	0.1525	113.0
113.1	2.83859	72.10022	1.39423	.065570	458.99	.0041102	28.7714	14.4375	1.5141	15.9516	27.1801	72.7899	99.97	.052852	.13462	.187472	81.13	.15268	113.1
113.2	2.84678	72.30824	1.39826	.06578	460.46	.0041214	28.8498	14.4400	1.5192	15.9592	27.2042	73.0258	100.23	.052894	.13504	.187934	81.23	.15286	113.2
113.3	2.85497	72.51626	1.40229	.06599	461.93	.0041326	28.9282	14.4425	1.5243	15.9668	27.2283	73.2617	100.49	.052936	.13546	.188396	81.33	.15304	113.3
113.4	2.86316	72.72428	1.40632	.06620	463.40	.0041438	29.0066	14.4450	1.5294	15.9744	27.2524	73.4976	100.75	.052978	.13588	.188858	81.43	.15322	113.4
113.5	2.87135	72.93230	1.41035	0.06641	464.87	0.0041550	29.0850	14.4475	1.5345	15.9820	27.2765	73.7335	101.01	0.053020	0.13630	0.189320	81.53	0.15340	113.5
113.6	2.87954	73.14032	1.41438	.06662	466.34	.0041662	29.1634	14.4500	1.5396	15.9896	27.3006	73.9694	101.27	.053062	.13672	.189782	81.63	.15358	113.6
113.7	2.88773	73.34834	1.41841	.06683	467.81	.0041774	29.2418	14.4525	1.5447	15.9972	27.3247	74.2053	101.53	.053104	.13714	.190244	81.73	.15376	113.7
113.8	2.89592	73.55636	1.42244	.06704	469.28	.0041886	29.3202	14.4550	1.5498	16.0048	27.3488	74.4412	101.79	.053146	.13756	.190706	81.83	.15394	113.8
113.9	2.90411	73.76438	1.42647	.06725	470.75	.0041998	29.3986	14.4575	1.5549	16.0124	27.3729	74.6771	102.05	.053188	.13798	.191168	81.93	.15412	113.9
114.0	2.9123	73.9724	1.4305	0.06746	472.22	0.004211	29.477	14.460	1.560	16.020	27.397	74.913	102.31	0.05323	0.1384	0.19163	82.03	0.15430	114.0
114.1	2.92069	74.18551	1.43462	.067676	473.732	.0042224	29.5568	14.4625	1.5653	16.0278	27.421	75.156	102.577	.053272	.13882	.192092	82.129	.15447	114.1
114.2	2.92908	74.39862	1.43874	.067892	475.244	.0042338	29.6366	14.4650	1.5706	16.0356	27.445	75.399	102.844	.053314	.13924	.192554	82.228	.15464	114.2
114.3	2.93747	74.6173	1.44286	.068108	476.756	.0042452	29.7164	14.4675	1.5759	16.0434	27.469	75.642	103.111	.053356	.13966	.193016	82.327	.15481	114.3
114.4	2.94586	74.82484	1.44698	.068324	478.268	.0042566	29.7962	14.4700	1.5812	16.0512	27.493	75.885	103.378	.053398	.14008	.193478	82.426	.15498	114.4
114.5	2.95425	75.03795	1.45110	0.068540	479.780	0.0042680	29.8760	14.4725	1.5865	16.0590	27.517	76.128	103.645	0.053440	0.14050	0.193940	82.525	0.15515	114.5
114.6	2.96264	75.25106	1.45522	.068756	481.292	.0042794	29.9558	14.4750	1.5918	16.0668	27.541	76.371	103.912	.053482	.14092	.194402	82.624	.15532	114.6
114.7	2.97103	75.46417	1.45934	.068972	482.804	.0042908	30.0356	14.4775	1.5971	16.0746	27.565	76.614	104.179	.053524	.14134	.194864	82.723	.15549	114.7
114.8	2.97942	75.67728	1.46346	.069188	484.316	.0043022	30.1154	14.4800	1.6024	16.0824	27.589	76.857	104.446	.053566	.14176	.195326	82.822	.15566	114.8
114.9	2.98781	75.89039	1.46758	.069404	485.828	.0043136	30.1952	14.4825	1.6077	16.0902	27.613	77.100	104.713	.053608	.14218	.195788	82.921	.15583	114.9
115.0	2.9962	76.1035	1.4717	0.06962	487.34	0.004325	30.275	14.485	1.613	16.098	27.637	77.343	104.98	0.05365	0.1426	0.19625	83.02	0.1560	115.0
115.1	3.00479	76.32106	1.47592	.069843	488.901	.0043366	30.3562	14.4875	1.6185	16.106	27.6611	77.5939	105.255	.053692	.14304	.196732	83.12	.15617	115.1
115.2	3.01338	76.53986	1.48014	.070066	490.462	.0043482	30.4374	14.4900	1.6240	16.114	27.6852	77.8448	105.530	.053734	.14348	.197214	83.22	.15634	115.2
115.3	3.02197	76.75804	1.48486	.070289	492.023	.0043598	30.5186	14.4925	1.6295	16.122	27.7093	78.0957	105.805	.053776	.14392	.197696	83.32	.15651	115.3
115.4	3.03056	76.97622	1.48858	.070512	493.584	.0043714	30.5998	14.4950	1.6350	16.130	27.7334	78.3466	106.080	.053818	.14436	.198178	83.42	.15668	115.4
115.5	3.03915	77.19440	1.49280	0.070735	495.145	0.0043830	30.6810	14.4975	1.6405	16.138	27.7575	78.5975	106.355	0.053860	0.14480	0.198660	83.52	0.15685	115.5
115.6	3.04774	77.41258	1.49702	.070958	496.706	.0043946	30.7622	14.5000	1.6460	16.146	27.7816	78.8484	106.630	.053902	.14524	.198142	83.62	.15702	115.6
115.7	3.05633	77.63076	1.50124	.071181	498.267	.0044062	30.8434	14.5025	1.6515	16.154	27.8057	79.0993	106.905	.053944	.14568	.199624	83.72	.15719	115.7
115.8	3.06492	77.84894	1.50546	.071404	499.828	.0044178	30.9246	14.5050	1.6570	16.162	27.8298	79.3502	107.180	.053986	.14612	.200126	83.82	.15736	115.8
115.9	3.07351	78.06712	1.50968	.071627	501.389	.0044294	31.0058	14.5075	1.6625	16.170	27.8539	79.6011	107.455	.054028	.14656	.200588	83.92	.15753	115.9
116.0	3.0821	78.2853	1.5139	0.07185	502.95	0.004441	31.087	14.510	1.668	16.178	27.878	79.852	107.73	0.05407	0.1470	0.20107	84.02	0.1577	116.0
116.1	3.09090	78.50882	1.51822	.072080	504.56	.004453	31.1710	14.5126	1.6735	16.1861	27.9021	80.1099	108.012	.054112	.14745	.201562	84.12	.15788	116.1
116.2	3.09970	78.73234	1.52254	.07231	506.17	.004465	31.2566	14.5152	1.6790	16.1942	27.9262	80.3678	108.294	.054154	.14790	.202054	84.22	.15806	116.2
116.3	3.10850	78.95586	1.52686	.072254	507.78	.004477	31.339	14.5178	1.6845	16.2023	27.9503	80.6257	108.576	.054196	.14835	.202546	84.32	.15824	116.3
116.4	3.11730	79.17938	1.53118	.072477	509.39	.004489	31.423	14.5204	1.6900	16.2104	27.9744	80.8836	108.858	.054238	.14880	.203038	84.42	.15842	116.4
116.5	3.12610	79.40290	1.53550	0.07300	511.00	0.004501	31.507	14.5230	1.6955	16.2185	27.9985	81.1415	109.140	0.054280	0.14925	0.203530	84.52	0.15860	116.5
116.6	3.13490	79.62642	1.53982	.073223	512.61	.004513	31.591	14.5256	1.7010	16.2266	28.0226	81.3994	109.422	.054322	.14970	.204022	84.62	.15878	116.6
116.7	3.14370	79.84994	1.54414	.073446	514.22	.004525	31.675	14.5282	1.7065	16.2347	28.0467	81.6573	109.704	.054364	.15015	.204514	84.72	.15896	116.7
116.8	3.15250	80.07346	1.54846	.073669	515.83	.004537	31.759	14.5308	1.7120	16.2428	28.0708	81.9152	109.986	.054406	.15060	.205006	84.82	.15914	116.8
116.9	3.16130	80.29698	1.55278	.073892	517.44	.004549	31.843	14.5334	1.7175	16.2509	28.0949	82.1731	110.268	.054445	.15105	.205498	84.92	.15932	116.9

117.0	3.1701	80.5205	1.5571	0.07415	519.05	0.004561	31.927	14.536	1.723	16.259	28.119	82.431	110.55	0.05449	0.1515	0.20599	85.02	0.15950	117.0
117.1	3.17912	80.74961	1.56153	.074387	520.709	.0045732	32.0124	14.5385	1.7289	16.2674	28.143	82.698	110.841	.054531	.15197	.206501	85.12	.15967	117.1
117.2	3.18814	80.97872	1.56596	.074624	522.368	.0045854	32.0978	14.5410	1.7348	16.2758	28.167	82.965	111.132	.054572	.15244	.207012	85.22	.15984	117.2
117.3	3.19716	81.20783	1.57039	.074861	524.027	.0045976	32.1832	14.5435	1.7407	16.2842	28.191	83.232	111.423	.054613	.15291	.207523	85.32	.16001	117.3
117.4	3.20618	81.43694	1.57482	.075098	525.686	.0046098	32.2686	14.5460	1.7466	16.2926	28.215	83.499	111.714	.054654	.15338	.208034	85.42	.16018	117.4
117.5	3.21520	81.66605	1.57925	0.075335	527.345	0.004622	32.3540	14.5485	1.7525	16.3010	28.239	83.766	112.005	0.054695	0.15385	0.208545	85.52	0.16035	117.5
117.6	3.22422	81.89516	1.58368	.075572	529.004	.0046342	32.4394	14.5510	1.7584	16.3094	28.263	84.033	112.296	.054736	.15432	.209056	85.62	.16052	117.6
117.7	3.23324	82.12427	1.58811	.075809	530.663	.0046464	32.5248	14.5535	1.7643	16.3178	28.287	84.300	112.587	.054777	.15479	.209556	85.72	.16069	117.7
117.8	3.24226	82.35338	1.59254	.076046	532.322	.0046586	32.6102	14.5560	1.7702	16.3262	28.311	84.567	112.878	.054818	.15526	.210078	85.82	.16086	117.8
117.9	3.25128	82.58249	1.59697	.076283	533.981	.0046708	32.6956	14.5585	1.7761	16.3346	28.335	84.834	113.169	.054859	.15573	.210589	85.92	.16103	117.9
118.0	3.2603	82.8116	1.6014	0.07652	535.64	0.004683	32.781	14.561	1.782	16.343	28.359	85.101	113.46	0.05490	0.1562	0.2111	86.02	0.1612	118.0
118.1	3.26954	83.0463	1.60594	.076765	537.355	.0046954	32.8678	14.5635	1.788	16.3515	28.3831	85.3769	113.76	.054942	.15668	.211622	86.12	.16137	118.1
118.2	3.27878	83.2810	1.61048	.077010	539.070	.0047078	32.9546	14.5660	1.794	16.3600	28.4072	85.6528	114.06	.054984	.15716	.212144	86.22	.16154	118.2
118.3	3.28802	83.5157	1.61502	.077255	540.785	.0047202	33.0414	14.5685	1.800	16.3685	28.4313	85.9287	114.36	.055026	.15764	.212666	86.32	.16171	118.3
118.4	3.29726	83.7504	1.61956	.077500	542.500	.0047326	33.1282	14.5710	1.806	16.3770	28.4554	86.2046	114.66	.055068	.15812	.213188	86.42	.16188	118.4
118.5	3.30655	83.9851	1.62410	0.077745	544.215	0.0047450	33.2150	14.5735	1.812	16.3855	28.4795	86.4805	114.96	0.055110	0.15860	0.213710	86.52	0.16205	118.5
118.6	3.31574	84.2198	1.62864	.077990	545.930	.0047574	33.3018	14.5760	1.818	16.3940	28.5036	86.7564	115.26	.055152	.15908	.214234	86.62	.16222	118.6
118.7	3.32498	84.4545	1.63318	.078235	547.645	.0047698	33.3886	14.5785	1.824	16.4025	28.5277	87.0323	115.56	.055194	.15956	.214754	86.72	.16239	118.7
118.8	3.33422	84.6892	1.63772	.078480	549.360	.0047822	33.4754	14.5810	1.830	16.4110	28.5518	87.3082	115.86	.055236	.16004	.215276	86.82	.16256	118.8
118.9	3.34346	84.9239	1.64226	.078725	551.075	.0047946	33.5622	14.5835	1.836	16.4195	28.5759	87.5841	116.16	.055278	.16052	.215798	86.92	.16273	118.9
119.0	3.3527	85.1586	1.6468	0.07897	552.79	0.004807	33.649	14.586	1.847	16.428	28.600	87.860	116.46	0.05532	0.1610	0.21632	87.02	0.1629	119.0
119.1	3.36217	85.39914	1.65145	.079222	554.554	.0048197	33.7379	14.5885	1.8483	16.4368	28.6241	88.1439	116.768	.055361	.16149	.216851	87.119	.16307	119.1
119.2	3.37164	85.63968	1.65610	.079474	556.318	.0048324	33.8268	14.5910	1.8546	16.4456	28.6482	88.4278	117.076	.055402	.16198	.217382	87.218	.16324	119.2
119.3	3.38111	85.88022	1.66075	.079726	558.082	.0048451	33.9157	14.5935	1.8609	16.4544	28.6723	88.7117	117.384	.055443	.16247	.217913	87.317	.16341	119.3
119.4	3.39058	86.12076	1.66540	.079978	559.846	.0048578	34.0046	14.5960	1.8672	16.4632	28.6964	88.9956	117.692	.055484	.16296	.218444	87.416	.16358	119.4
119.5	3.40005	86.36130	1.67005	0.080230	561.610	0.0048705	34.0935	14.5985	1.8735	16.4720	28.7205	89.2795	118.000	0.055525	0.16345	0.218975	87.515	0.16375	119.5
119.6	3.40952	86.60184	1.67470	.080482	563.374	.0048832	34.1824	14.6010	1.8798	16.4808	28.7446	89.5634	118.308	.055566	.16394	.219506	87.614	.16392	119.6
119.7	3.41899	86.84238	1.67935	.080734	565.138	.0048959	34.2713	14.6035	1.8861	16.4896	28.7687	89.8473	118.616	.055607	.16443	.220037	87.713	.16409	119.7
119.8	3.42846	87.08292	1.68400	.080986	566.902	.0049086	34.3602	14.6060	1.8924	16.4984	28.7928	90.1312	118.924	.055648	.16492	.220568	87.812	.16426	119.8
119.9	3.43793	87.32346	1.68865	.081238	568.666	.0049213	34.4491	14.6085	1.8987	16.5072	28.8169	90.4151	119.232	.055689	.16541	.221099	87.911	.16443	119.9
120.0	3.4474	87.5640	1.6933	0.08149	570.43	0.004934	34.538	14.611	1.905	16.516	28.841	90.699	119.54	0.05573	0.1659	0.22163	88.010	0.1646	120.0
120.1	3.45769	87.81012	1.69806	.081751	572.257	.0049471	34.6297	14.6136	1.9113	16.5249	28.8651	90.9929	119.858	.055772	.16641	.222182	88.11	.16478	120.1
120.2	3.46678	88.05624	1.70282	.082012	574.084	.0049602	34.7214	14.6162	1.9176	16.5338	28.8892	91.2868	120.176	.055814	.16692	.222734	88.21	.16496	120.2
120.3	3.47647	88.30236	1.70758	.082273	575.911	.0049733	34.8131	14.6188	1.9239	16.5427	28.9133	91.5807	120.494	.055856	.16743	.223286	88.31	.16514	120.3
120.4	3.48616	88.54848	1.71234	.082534	577.738	.0049864	34.9048	14.6214	1.9302	16.5516	28.9374	91.8746	120.812	.055898	.16794	.223838	88.41	.16532	120.4
120.5	3.49585	88.79460	1.71710	0.082795	579.565	0.0049995	34.9965	14.6240	1.9365	16.5605	28.9615	92.1685	121.130	0.055940	0.16845	0.224390	88.51	0.16550	120.5
120.6	3.50554	89.04072	1.72186	.083056	581.392	.0050126	35.0882	14.6266	1.9428	16.5694	28.9856	92.4624	121.448	.055982	.16896	.224942	88.61	.16568	120.6
120.7	3.51523	89.28684	1.72662	.083317	583.219	.0050257	35.1799	14.6292	1.9491	16.5783	29.0097	92.7563	121.766	.056024	.16947	.225494	88.71	.16586	120.7
120.8	3.52492	89.53296	1.73138	.083578	585.046	.0050388	35.2716	14.6318	1.9554	16.5872	29.0338	93.0502	122.084	.056066	.16998	.226046	88.81	.16604	120.8
120.9	3.53461	89.77908	1.73614	.083839	586.873	.0050519	35.3633	14.6344	1.9617	16.5961	29.0579	93.3441	122.402	.056108	.17049	.226598	88.91	.16622	120.9
121.0	3.5443	90.0252	1.7409	0.08410	588.70	0.005065	35.455	14.637	1.968	16.605	29.082	93.638	122.72	0.05615	0.1710	0.22715	89.01	0.1664	121.0
121.1	3.55423	90.27742	1.74578	.084368	590.526	.0050783	35.5481	14.6395	1.9748	16.6141	29.106	93.940	123.046	.056191	.17153	.227721	89.11	.16657	121.1
121.2	3.56416	90.52964	1.75066	.084636	592.452	.0050916	35.6412	14.6420	1.9812	16.6232	29.130	94.242	123.372	.056232	.17206	.228292	89.21	.16674	121.2
121.3	3.57409	90.78186	1.75554	.084904	594.328	.0051049	35.7343	14.6445	1.9878	16.6323	29.154	94.544	123.698	.056273	.17259	.228863	89.31	.16691	121.3
121.4	3.58402	91.03408	1.76042	.085172	596.204	.0051182	35.8274	14.6470	1.9944	16.6414	29.178	94.846	124.024	.056314	.17312	.229434	89.41	.16708	121.4

121.5	3.59395	91.28630	1.76530	0.085440	598.080	0.0051315	35.9205	14.6495	2.0010	16.6505	29.202	95.148	124.350	0.056355	0.17365	0.230005	89.51	0.16725	121.5
121.6	3.60388	91.53852	1.77018	.085708	599.956	.0051448	36.0136	14.6520	2.0076	16.6596	29.226	95.450	124.676	.056396	.17418	.230576	89.61	.16742	121.6
121.7	3.61381	91.79074	1.77506	.085976	601.832	.0051581	36.1067	14.6545	2.0142	16.6687	29.250	95.752	125.002	.056437	.17471	.231147	89.71	.16759	121.7
121.8	3.62374	92.04296	1.77994	.086244	603.708	.0051714	36.1998	14.6570	2.0208	16.6778	29.274	96.054	125.328	.056478	.17524	.231718	89.81	.16776	121.8
121.9	3.63367	92.29518	1.78482	.086512	605.584	.0051847	36.2929	14.6595	2.0274	16.6869	29.298	96.356	125.654	.056519	.17577	.232289	89.91	.16793	121.9
122.0	3.6436	92.54774	1.7897	0.08678	607.46	0.005198	36.386	14.662	2.034	16.696	29.322	96.658	125.98	0.056560	0.17630	0.232860	90.01	0.16810	122.0
122.1	3.65376	92.80547	1.79469	.087057	609.399	.0052116	36.4805	14.6645	2.0409	16.7054	29.3461	96.9709	126.317	.056602	.17684	.233442	90.11	.16827	122.1
122.2	3.66392	93.06354	1.79968	.087334	611.338	.0052252	36.5750	14.6670	2.0478	16.7148	29.3702	97.2838	126.654	.056644	.17738	.234024	90.21	.16844	122.2
122.3	3.67408	93.32161	1.80467	.087611	613.277	.0052388	36.6695	14.6695	2.0547	16.7242	29.3943	97.5967	126.991	.056686	.17792	.234606	90.31	.16861	122.3
122.4	3.68424	93.57968	1.80966	.087888	615.216	.0052524	36.7640	14.6720	2.0616	16.7336	29.4184	97.9096	127.328	.056728	.17846	.235188	90.41	.16878	122.4
122.5	3.69440	93.83775	1.81465	0.088165	617.155	0.0052660	36.8585	14.6745	2.0685	16.7430	29.4425	98.2225	127.665	0.056770	0.17900	0.235770	90.51	0.16895	122.5
122.6	3.70456	94.09582	1.81964	.088442	619.094	.0052796	36.9530	14.6770	2.0754	16.7524	29.4666	98.5354	128.002	.056812	.17954	.236352	9061	.16912	122.6
122.7	3.71472	94.35389	1.82463	.088719	621.033	.0052932	37.0475	14.6795	2.0823	16.7618	29.4907	98.8483	128.339	.056854	.18008	.236934	9071	.16929	122.7
122.8	3.72488	94.61196	1.82962	.088996	622.972	.0053068	37.1420	14.6820	2.0892	16.7712	29.5148	99.1612	128.676	.056896	.18062	.237516	9081	.16946	122.8
122.9	3.73504	94.87003	1.83461	.089273	624.911	.0053204	37.2365	14.6845	2.0961	16.7806	29.5389	99.4741	129.013	.056938	.18116	.238098	9091	.16963	122.9
123.0	3.7452	95.1281	1.8396	0.08955	626.85	0.005334	37.331	14.687	2.103	16.790	29.563	99.787	129.35	0.056980	0.18170	0.238680	91.01	0.16980	123.0
123.1	3.75561	95.39251	1.84471	.089837	628.859	.0053479	37.429	14.6895	2.1101	16.7996	29.5871	100.1079	129.695	.057021	.18225	.239271	91.11	.16997	123.1
123.2	3.76602	95.65692	1.84982	.090124	630.868	.0053618	37.527	14.6920	2.1172	16.8092	29.6112	100.4288	130.040	.057062	.18280	.239862	91.21	.17014	123.2
123.3	3.77643	95.92133	1.85493	.090411	632.877	.0053757	37.625	14.6945	2.1243	16.8188	29.6353	100.7497	130.385	.057103	.18335	.240453	91.31	.17031	123.3
123.4	3.78684	96.18574	1.86004	.090698	634.886	.0053896	37.723	14.6970	2.1314	16.8284	29.6594	101.0706	130.730	.057144	.18390	.241044	91.41	.17048	123.4
123.5	3.79725	96.45015	1.86515	0.090985	636.895	0.0054035	37.821	14.6995	2.1385	16.8380	29.6835	101.3915	131.075	0.057185	0.18445	0.241635	91.51	0.17065	123.5
123.6	3.80766	96.71456	1.87026	.091272	638.904	.0054174	37.919	14.7020	2.1456	16.8476	29.7076	101.7124	131.420	.057226	.18500	.242226	91.61	.17082	123.6
123.7	3.81807	96.97897	1.87537	.091559	640.913	.0054313	38.017	14.7045	2.1527	16.8572	29.7317	102.0333	131.765	.057267	.18555	.242817	91.71	.17099	123.7
123.8	3.82848	97.24338	1.88048	.091846	642.922	.0054452	38.115	14.7070	2.1598	16.8668	29.7558	102.3542	132.110	.057308	.18610	.243408	91.81	.17116	123.8
123.9	3.83889	97.50779	1.88559	.092133	644.931	.0054591	38.213	14.7095	2.1669	16.8764	29.7799	102.6751	132.455	.057349	.18665	.243999	91.81	.17133	123.9
124.0	3.8493	97.7722	1.8907	0.09242	646.94	0.005473	38.311	14.712	2.174	16.886	29.804	102.996	132.800	0.057390	0.18720	0.244590	92.01	0.17150	124.0
124.1	3.85995	98.04271	1.89593	.092715	649.005	.0054872	38.4104	14.7146	2.1813	16.8959	29.828	103.332	133.160	.057431	.18778	.245211	92.11	.17167	124.1
124.2	3.87060	98.31322	1.90116	.093010	651.070	.0055014	38.5098	14.7172	2.1886	16.9058	29.852	103.668	133.520	.057472	.18836	.245832	92.21	.17184	124.2
124.3	3.88125	98.58373	1.90639	.093305	653.135	.0055156	38.6092	14.7198	2.1959	16.9157	29.876	104.004	133.880	.057513	.18894	.246453	92.31	.17201	124.3
124.4	3.89190	98.85424	1.91162	.093600	655.200	.0055298	38.7086	14.7224	2.2032	16.9256	29.900	104.340	134.240	.057554	.18952	.247074	92.41	.17218	124.4
124.5	3.90255	99.12475	1.91685	0.093895	657.265	0.0055440	38.8080	14.7250	2.2105	16.9355	29.924	104.676	134.600	0.057595	0.1901	0.247695	92.51	0.17235	124.5
124.6	3.91320	99.39526	1.92208	.094190	659.330	.0055582	38.9074	14.7276	2.2178	16.9454	29.948	105.012	134.960	.057636	.19068	.248316	92.61	.17252	124.6
124.7	3.92385	99.66577	1.92731	.094485	661.395	.0055724	39.0068	14.7302	2.2251	16.9553	29.972	105.348	135.320	.057677	.19126	.248937	92.71	.17269	124.7
124.8	3.93450	99.93628	1.93254	.094780	663.460	.0055866	39.1062	14.7328	2.2324	16.9652	29.996	105.684	135.680	.057718	.19184	.249558	92.81	.17286	124.8
124.9	3.94515	100.20679	1.93777	.095075	665.525	.0056008	39.2056	14.7354	2.2397	16.9751	30.020	106.020	136.040	.057759	.19242	.250179	92.91	.17303	124.9
125.0	3.9558	100.4773	1.9430	0.09537	667.59	0.005615	39.305	14.738	2.247	16.985	30.044	106.356	136.400	0.057780	0.1930	0.25080	93.01	0.17324	125.0
125.1	3.96671	100.75442	1.94836	.095674	669.718	.0056295	39.4065	14.7405	2.2546	16.9951	30.0681	106.7019	136.770	.057841	.19359	.251431	93.11	.17337	125.1
125.2	3.97762	101.03154	1.95312	.095978	671.846	.0056440	39.5080	14.7430	2.2622	17.0052	30.0922	107.0478	137.140	.057882	.19418	.252062	93.21	.17354	125.2
125.3	3.98853	101.30866	1.95908	.096282	673.974	.0056585	39.6095	14.7455	2.2698	17.0153	30.1163	107.3937	137.510	.057923	.19477	.252693	93.31	.17371	125.3
125.4	3.99944	101.58578	1.96444	.096586	676.102	.0056730	39.7110	14.7480	2.2774	17.0254	30.1404	107.7396	137.880	.057964	.19536	.253324	93.41	.17388	125.4
125.5	4.01035	101.86290	1.96980	0.096890	678.230	0.0056875	39.8125	14.7505	2.2850	17.0355	30.1645	108.0855	138.250	0.058005	0.19595	0.253955	93.51	0.17405	125.5
125.6	4.02126	102.14002	1.97516	.097194	680.358	.0057020	39.9140	14.7530	2.2926	17.0456	30.1886	108.4314	138.620	.058046	.19654	.254586	93.61	.17422	125.6
125.7	4.03217	102.41714	1.98052	.097498	682.486	.0057165	40.0155	14.7555	2.3002	17.0557	30.2127	108.7773	138.990	.058087	.19713	.255217	93.71	.17439	125.7
125.8	4.04308	102.69426	1.98588	.097802	684.614	.0057310	40.1170	14.7580	2.3078	17.0658	30.2368	109.1232	139.360	.058128	.19772	.255848	93.81	.17456	125.8
125.9	4.05399	102.97138	1.99124	.098106	686.742	.0057455	40.2185	14.7605	2.3154	17.0759	30.2609	109.4691	139.730	.058169	.19831	.256479	93.91	.17473	125.9

126.0	4.0645	103.2485	1.9966	0.09841	688.87	0.005160	40.320	14.763	2.323	17.086	30.285	109.815	140.100	0.058210	0.1989	0.25911	94.01	0.17490	126.0
126.1	4.07606	103.55197	2.00208	.098729	691.103	.0057751	40.4257	14.7655	2.3308	17.0963	30.3091	110.1709	140.480	.058251	.19951	.258761	94.109	.17507	126.1
126.2	4.08722	103.81544	2.00756	.099048	693.336	.0057902	40.5314	14.7680	23386	17.1066	30.3332	110.5268	140.860	.058292	.20012	.258412	94.208	.17524	126.2
126.3	4.09838	104.09891	2.01304	.099367	695.569	.0058053	40.6371	14.7705	2.3464	17.1169	30.3573	110.8827	141.240	.058333	.20073	.259063	94.307	.17541	126.3
126.4	4.10954	104.38238	2.01852	.099686	697.802	.0058204	40.7428	14.7730	2.3542	17.1272	30.3814	111.2386	141.620	.058374	.20134	.259714	94.406	.17558	126.4
126.5	4.12070	104.66585	2.02400	0.100005	700.035	0.0058355	40.8485	14.7755	2.3620	17.1375	30.4055	111.5945	142.000	0.058415	0.20195	0.260365	94.505	0.17575	126.5
126.6	4.13186	104.94932	2.02948	.100324	702.268	.0058502	40.9542	14.7780	2.3698	17.1478	30.4295	111.9504	142.38	.058456	.20256	.261016	94.604	.17592	126.6
126.7	4.14302	105.23279	2.03496	.100643	704.501	.0058657	41.0599	14.7805	2.3776	17.1581	30.4537	112.3063	142.76	.058497	.20317	.261667	94.703	.17609	126.7
126.8	4.15418	105.51626	2.04044	.100962	706.734	.0058808	41.1656	14.7830	2.3854	17.1684	30.4778	112.6622	143.14	.058538	.20378	.262318	94.802	.17626	126.8
126.9	4.16534	105.79973	2.04592	.101281	708.967	.0058959	41.2713	14.7855	23932	17.1787	30.5019	113.0181	143.52	.058579	.20439	.262969	94.901	.17643	126.9
127.0	4.1765	106.0832	2.05714	0.1016	711.2	0.005911	41.377	14.788	2.401	17.189	30.526	113.375	143.900	0.058620	0.20500	0.263622	95.00	0.17660	127.0
127.1	4.18792	106.37326	2.05701	.10192	713.44	.0059262	41.4834	14.7905	2.4091	17.1996	30.550	113.740	144.29	.058661	.20563	.264291	95.1	.17677	127.1
127.2	4.19934	106.66332	2.06262	.10224	715.68	.0059414	41.5898	14.7930	2.4172	17.2102	30.574	114.106	144.68	.058702	.20626	.264912	95.2	.17694	127.2
127.3	4.21076	106.95338	2.06823	.10256	717.92	.0059566	41.6962	14.7955	2.4253	17.2208	30.598	114.472	145.07	.058743	.20689	.265633	95.3	.17711	127.3
127.4	4.22218	107.24344	2.07384	.10288	720.16	.0059718	41.8026	14.7980	2.4334	17.2314	30.622	114.838	145.46	.058784	.20752	.266304	95.4	.17728	127.4
127.5	4.23360	107.53350	2.07945	0.10320	722.40	0.005987	41.9090	14.8005	2.4415	17.2420	30.646	115.204	145.85	0.058825	0.20815	0.266975	95.5	0.17745	127.5
127.6	4.24502	107.82356	2.08506	.10352	724.64	.0060022	42.0154	14.8030	2.4496	17.2526	30.670	115.570	146.24	.058866	.20878	.267646	95.6	.17762	127.6
127.7	4.25644	108.11362	2.09067	.10384	726.88	.0060174	42.1218	14.8055	2.4577	17.2632	30.694	115.936	146.63	.058907	.20941	.268317	95.7	.17779	127.7
127.8	4.26786	108.40368	2.09628	.10416	729.12	.0060326	42.2282	14.8080	2.4658	17.2738	30.718	116.302	147.02	.058948	.21004	.268988	95.8	.17796	127.8
127.9	4.27928	108.69374	2.10189	.10448	731.36	.0060478	42.3346	14.8105	2.4739	17.2844	30.742	116.668	147.41	.058989	.21067	.269659	95.9	.17813	127.9
128.0	4.2907	108.9838	2.1075	0.1048	733.6	0.006063	42.441	14.813	2.482	17.295	30.766	117.034	147.800	0.059030	0.2113	0.27033	96.0	0.17830	128.0
128.1	4.30239	109.28072	2.11324	.10514	735.98	.0060784	42.5488	14.8156	2.4903	17.3059	30.7901	117.4099	148.200	.059071	.21195	.271021	96.1	.17847	128.1
128.2	4.31408	109.57764	2.11898	.10548	738.36	.0060938	42.6566	14.8182	2.4986	17.3168	30.8142	117.7858	148.600	.059112	.21260	.271712	96.2	.17864	128.2
128.3	4.32577	109.87456	2.12472	.10582	740.74	.0061092	42.7644	14.8208	2.5069	17.3277	30.8383	118.1617	149.00	.059153	.21325	.272403	96.3	.17881	128.3
128.4	4.33746	110.17148	2.13046	.10616	743.12	.0061246	42.8722	14.8234	2.5152	17.3386	30.8624	118.5376	149.400	.059194	.21390	.273094	96.4	.17898	128.4
128.5	4.34915	110.46840	2.13620	0.10650	745.50	0.006140	42.9800	14.8260	2.5235	17.3495	30.8865	118.9135	149.800	0.059235	0.21455	0.273785	96.5	0.17915	128.5
128.6	4.36084	110.76532	2.14194	.10684	747.88	.0061554	43.0878	14.8286	2.5318	17.3604	30.9106	119.2894	150.200	.059276	.2152	.274476	96.6	.17932	128.6
128.7	4.37253	111.06224	2.14768	.10718	750.26	.0061708	43.1956	14.8312	2.5401	17.3713	30.9347	119.6653	150.600	.059317	.21585	.275167	96.7	.17949	128.7
128.8	4.38422	111.35916	2.15342	.10752	752.64	.0061862	43.3034	14.8338	2.5484	17.3822	30.9588	120.0412	151.000	.059358	.21650	.275858	96.8	.17966	128.8
128.9	4.39591	111.65608	2.15916	.10786	755.02	.0062016	43.4112	14.8364	2.5567	17.3931	30.9829	120.4171	151.400	.059399	.21715	.276549	96.9	.17983	128.9
129.0	4.4076	111.9530	2.1649	0.1082	757.4	0.006217	43.519	14.839	2.565	17.404	31.007	120.793	151.800	0.059440	0.2178	0.27724	97.0	0.1800	129.0
129.1	4.41956	112.25679	2.17078	.10854	759.78	.0062324	43.6268	14.8415	2.5737	17.4152	31.0311	121.1789	152.210	.059481	.21847	.277951	97.1	.18017	129.1
129.2	4.43152	112.56058	2.17666	.10888	762.16	.0062478	43.7346	14.8440	2.5824	17.4264	31.0552	121.5648	152.620	.059522	.21914	.278662	97.2	.18034	129.2
129.3	4.44348	112.86437	2.18254	.10922	764.54	.006232	43.8424	14.8465	2.5911	17.4376	31.0793	121.9507	153.030	.059563	.21981	.279373	97.3	.18051	129.3
129.4	4.45544	113.16816	2.18842	.10956	766.92	.0062786	43.9502	14.8490	2.5998	17.4488	31.1034	122.3366	153.440	.059604	.22048	.280084	97.4	.18068	129.4
129.5	4.46740	113.47195	2.19430	0.10990	769.30	0.006240	44.0580	14.8515	2.6085	17.4600	31.1275	122.7225	153.850	0.059645	0.22115	0.280795	97.5	0.18085	129.5
129.6	4.47936	113.77574	2.20018	.11024	771.68	.0063094	44.1658	14.8540	2.6172	17.4712	31.1515	123.1084	154.260	.059686	.22182	.281506	97.6	.18102	129.6
129.7	4.49132	114.07953	2.20606	.11058	774.06	.0063248	44.2736	14.8565	2.6259	17.4824	31.1757	123.4943	154.670	.059727	.22249	.282217	97.7	.18119	129.7
129.8	4.50328	114.38332	2.21194	.11092	776.44	.0063402	44.3814	14.8590	2.6346	17.4936	31.1998	123.8802	155.080	.059768	.22316	.282928	97.8	.18136	129.8
129.9	4.51524	114.68711	2.21782	.11126	778.82	.0063556	44.4892	14.8615	2.6433	17.5048	31.2239	124.2661	155.490	.059809	.22383	.283639	97.9	.18153	129.9
130.0	4.5272	114.9909	2.2237	0.1116	781.2	0.006371	44.597	14.864	2.652	17.516	31.248	124.652	155.900	0.059850	0.2245	0.28435	98.0	0.18170	130.0
130.1	4.53943	115.30154	2.22971	.11196	783.72	.0063873	44.7111	14.8665	2.661	17.5275	31.2721	125.0679	156.340	.059891	.22519	.285081	98.1	.18187	130.1
130.2	4.55166	115.61218	2.23572	.11232	786.24	.0064036	44.8252	14.8690	2.670	17.5390	31.2962	125.4838	156.780	.059932	.22588	.285812	98.2	.18204	130.2
130.3	4.56389	115.92282	2.24173	.11268	788.76	.0064199	44.9393	14.8715	2.679	17.5505	31.3203	125.8997	157.220	.059973	.22657	.286543	98.3	.18221	130.3
130.4	4.57612	116.23346	2.24774	.11304	791.28	.0064362	45.0534	14.8740	2.688	17.5620	31.3444	126.3156	157.660	.060014	.22726	.287274	98.4	.18238	130.4

130.5	4.58835	116.54410	2.25375	0.11340	793.80	0.0064525	45.1675	14.8765	2.697	17.5736	31.3685	126.7315	158.100	0.060055	0.22795	0.288005	98.5	0.18255	130.5
130.6	4.60058	116.85474	2.25976	.11376	796.32	.0064688	45.2816	14.8790	2.706	17.5850	31.3926	127.1474	158.540	.060096	.22864	.288736	98.6	.18272	130.6
130.7	4.61281	117.16538	2.26577	.11412	798.84	.0064851	45.3957	14.8815	2.715	17.5965	31.4167	127.5633	158.980	.060137	.22933	.289467	98.7	.18289	130.7
130.8	4.62504	117.47602	2.27178	.11448	801.36	.0065014	45.5098	14.8840	2.724	17.6080	31.4408	127.9792	159.420	.060178	.223002	.290198	98.8	.18306	130.8
130.9	4.63727	117.78666	2.27779	.11484	803.88	.0065177	45.6239	14.8865	2.733	17.6195	31.4649	128.3951	159.860	.060219	.23071	.290929	98.9	.18323	130.9
131.0	4.64995	118.09773	2.28838	0.11520	806.4	0.0065534	45.738	14.889	2.742	17.631	31.489	128.811	160.300	0.060286	0.23114	0.29166	99.0	0.1834	131.0
131.1	4.66202	118.41531	2.28994	.11557	808.99	.0065505	45.8535	14.8916	2.7512	17.6428	31.513	129.227	160.174	.060301	.23212	.292421	99.1	.18357	131.1
131.2	4.67454	118.73332	2.29608	.11594	811.58	.006567	45.9690	14.8942	2.7604	17.6546	31.537	129.648	161.180	.060342	.23284	.293182	99.2	.18374	131.2
131.3	4.68706	119.05133	2.30222	.11631	814.17	.0065835	46.0845	14.8968	2.7696	17.6664	31.561	130.059	161.620	.060383	.23356	.293943	99.3	.18391	131.3
131.4	4.69958	119.36934	2.30836	.11668	816.76	.0066000	46.2000	14.8994	2.7788	17.6782	31.585	130.475	162.060	.060424	.23428	.294704	99.4	.18408	131.4
131.5	4.71210	119.68735	2.31450	0.11705	819.35	0.0066165	46.3155	14.9020	2.7880	17.6900	31.609	130.891	162.500	0.060465	0.23500	0.295465	99.5	0.18425	131.5
131.6	4.72462	120.00536	2.32064	.11742	821.94	.0066330	46.4310	14.9046	2.7972	17.7018	31.633	131.307	162.940	.060506	.23572	.296226	99.6	.18442	131.6
131.7	4.73714	120.32337	2.32678	.11779	824.53	.0066495	46.5465	14.9072	2.8064	17.7136	31.657	131.723	163380	.060547	.23644	.296987	99.7	.18459	131.7
131.8	4.74966	120.64138	2.33292	.11816	827.12	.0066660	46.6620	14.9098	2.8156	17.7254	31.681	132.139	163.820	.060588	.23716	.297748	99.8	.18476	131.8
131.9	4.76218	120.95939	2.33906	.11853	829.71	.0066825	46.7775	14.9124	2.8248	17.7372	31.705	132.555	164260	.060629	.23788	.298509	99.9	.18493	131.9
132.0	4.7747	121.2774	2.34520	0.1189	832.3	0.006699	46.893	14.915	2.834	17.749	31.729	132.971	164700	0.060670	0.23860	0.299270	100.0	0.1851	132.0
132.1	4.78751	121.66277	2.35149	.11928	834.96	.0067157	47.0103	14.9175	2.8436	17.7611	31.7531	133.4069	165.160	.060711	.23933	.300041	100.1	.18527	132.1
132.2	4.80032	121.92814	2.35778	.11966	837.62	.0067324	47.1276	14.9200	2.8532	17.7732	31.7772	133.8428	165.620	.060752	.24006	.300812	100.2	.18544	132.2
132.3	4.81313	122.25351	2.36407	.12004	840.28	.0067491	47.2449	14.9225	2.8628	17.7853	31.8013	134.2787	165.080	.060793	.24079	.301583	100.3	.18561	132.3
132.4	4.82594	122.57888	2.37036	.12042	845.94	.0067658	47.3622	14.9250	2.8724	17.7974	31.8254	134.7146	166.540	.060834	.24152	.302354	100.4	.18578	132.4
132.5	4.83875	122.90429	2.37665	0.12080	845.60	0.0067825	47.4795	14.9275	2.8820	17.8095	31.8495	135.1505	166.700	0.060875	0.24225	0.303125	100.5	0.18595	132.5
132.6	4.85156	123.22962	2.38294	.12118	848.26	.0067992	47.5968	14.9300	2.8916	17.8216	31.8736	135.5864	167.460	.060916	.24298	.303896	100.6	.18612	132.6
132.7	4.86437	123.55499	2.38923	.12156	850.92	.0068159	47.7141	14.9325	2.9012	17.8337	31.8977	136.0223	167.920	.060957	.24371	.304667	100.7	.18629	132.7
132.8	4.87718	123.88036	2.39552	.12194	853.58	.0068326	47.8314	14.9350	2.9108	17.8458	31.9218	136.4582	168.380	.060998	.24444	.305438	100.8	.18646	132.8
132.9	4.88999	124.20573	2.40181	.12232	856.24	.0068493	47.9489	14.9375	2.9204	17.8579	31.9459	136.8941	168.840	.061039	.24517	.306209	100.9	.18663	132.9
133.0	4.9028	124.5311	2.4081	0.12270	858.9	0.006866	48.066	14.940	2.930	17.870	31.970	137.330	169.300	0.061080	0.24590	0.30698	101.0	0.1868	133.0
133.1	4.91589	124.06359	2.41454	.1231	861.7	.0068835	48.1881	14.9425	2.9425	17.8824	31.9941	137.7758	169.770	.06112	.24667	.30779	101.1	.18697	133.1
133.2	4.92898	125.19608	2.42098	.12351	864.5	.0069010	48.3102	14.9450	2.9498	17.8948	32.0182	138.2218	170.240	.06116	.24744	.30860	101.2	.18714	133.2
133.3	4.94207	125.52857	2.42742	.12389	867.3	.0069185	48.4323	14.9475	2.9597	17.9072	32.0423	138.6677	170.710	.06120	.24821	.30941	101.3	.18731	133.3
133.4	4.95516	125.86106	2.43386	.12431	870.1	.0069360	48.5544	14.9500	2.9696	17.9196	32.0664	139.1136	171.180	.06124	.24898	.31022	101.4	.18748	133.4
133.5	4.96825	126.19355	2.44030	0.12471	872.9	0.0069535	48.6765	14.9525	2.9795	17.9320	32.0905	139.5595	171.650	0.06128	0.24975	0.31103	101.5	0.18765	133.5
133.6	4.98134	126.52604	2.44674	.12511	875.7	.0069710	48.7986	14.9550	2.9894	17.9444	32.1146	140.0054	172.120	.06132	.25052	.31184	101.6	.18782	133.6
133.7	4.99443	126.85853	2.45318	.12555	878.5	.0069885	48.9207	14.9575	2.9993	17.9568	32.1387	140.4513	172.590	.06136	.25129	.31265	101.7	.18799	133.7
133.8	5.00752	127.19102	2.45962	.12599	881.3	.0070006	49.0428	14.9600	3.0092	17.9692	32.1628	140.8972	173.060	.06140	.25206	.31346	101.8	.18816	133.8
133.9	5.02061	127.52351	2.46606	.12643	884.1	.0070235	49.1649	14.9625	3.0191	17.9816	32.1869	141.3431	173.530	.06144	.25283	.31427	101.9	.18833	133.9
134.0	5.0337	127.8560	2.4725	0.12687	886.9	0.007041	49.287	14.965	3.029	17.994	32.211	141.787	174.000	0.06148	0.25360	0.31508	102.0	0.1885	134.0
134.1	5.04709	128.19614	2.47907	.12711	889.77	.0070589	49.4123	14.9675	3.0393	18.0068	32.2351	142.2549	174.490	.061521	.25438	.315901	102.1	.18867	134.1
134.2	5.06048	128.53628	2.48564	.12752	892.64	.0070768	49.5376	14.9700	3.0496	18.0196	32.2592	142.7208	174980	.061562	.25516	.316722	102.2	.18884	134.2
134.3	5.07387	128.87642	2.49221	.12793	895.51	.0070947	49.6629	14.9725	3.0599	18.0324	32.2833	143.1867	175.470	.061603	.25594	.317543	102.3	.18901	134.3
134.4	5.08726	129.21656	2.49878	.12834	898.38	.0071126	49.7882	14.9750	3.0702	18.0452	32.3074	143.6526	175.960	.061644	.25672	.318364	102.4	.18918	134.4
134.5	5.10065	129.55670	2.50535	0.12875	901.25	0.0071305	49.9135	14.9775	3.0805	18.0580	32.3315	144.1185	176.450	0.061685	0.25750	0.319185	102.5	0.18935	134.5
134.6	5.11404	129.89684	2.51192	.12916	904.12	.0071484	50.0388	14.9800	3.0908	18.0708	32.3556	144.5844	176.940	.061726	.25820	.320006	102.6	.18952	134.6
134.7	5.12743	130.23698	2.51849	.12957	906.99	.0071663	50.1641	14.9825	3.1011	18.0836	32.3797	145.0503	177.430	.061767	.25906	.320827	102.7	.18969	134.7
134.8	5.14082	130.57712	2.52506	.12998	909.86	.0071842	50.2894	14.9850	3.1114	18.0964	32.4038	145.5162	177.920	.061808	.25984	.321648	102.8	.18986	134.8
134.9	5.15421	130.91726	2.53163	.13039	912.73	.0072021	50.4147	14.9875	3.1217	18.1092	32.4279	145.9821	178.410	.061849	.26062	.322469	102.9	.19003	134.9

135.0	5.1676	131.2574	2.5382	0.1308	915.6	0.0072120	50.5400	14.990	3.3132	18.122	32.452	146.448	178.900	0.06189	0.2614	0.32329	103.0	0.1902	135.0
135.1	5.18130	131.60534	2.54493	.13122	918.54	.0072381	50.6667	14.9926	3.1425	18.1351	32.476	146.924	179.400	.06193	.26221	.32414	103.1	.19036	135.1
135.2	5.19150	131.99328	2.55166	.13164	921.48	.0072562	50.7934	14.9952	3.1530	18.1482	32.500	147.400	179.900	.06197	.26302	.32499	103.2	.19052	135.2
135.3	5.20870	132.30122	2.55839	.13206	92442	.0072743	50.9201	14.9978	3.1635	18.1613	32.548	147.876	180.400	.06201	.26383	.32584	103.3	.19068	135.3
135.4	5.22240	132.64916	2.56512	.13248	92748	.0072924	51.0468	15.0004	3.1740	18.1744	32.548	148.352	180.900	.06205	.26464	.32669	103.4	.19084	135.4
135.5	5.23610	132.99710	2.57185	0.13290	930.30	0.0073105	51.1735	15.0030	3.1845	18.1875	32.572	148.828	181.400	0.06209	0.26545	0.32754	103.5	0.19100	135.5
135.6	5.24980	133.34504	2.57858	.13332	933.24	.0073286	51.3002	15.0056	3.1950	18.2006	32.596	149.304	181.900	.06213	.26626	.32839	103.6	.19116	135.6
135.7	5.26350	133.69298	2.58531	.13374	936.18	.0073467	51.4269	15.0082	3.2055	18.2137	32.620	149.780	182.400	.06217	.26707	.32924	103.7	.19132	135.7
135.8	5.27720	134.04092	2.59204	.13416	939.12	.0073648	51.5536	15.0108	3.2160	18.2268	32.644	150.256	182.900	.06221	.26788	.33005	103.8	.19148	135.8
135.9	5.29090	134.38886	2.59877	.13458	942.06	.0073829	51.6803	15.0134	3.2265	18.2399	32.668	150.732	183.400	.06225	.26869	.33094	103.9	.19164	135.9
136.0	5.3046	134.7368	2.60555	0.1350	945.0	0.0074010	51.807	15.016	3.237	18.253	32.692	151.208	183.900	0.06229	0.26950	0.33179	104.0	0.1918	136.0
136.1	5.31860	135.09440	2.61238	.13543	948.01	.0074193	51.9351	15.0185	3.2481	18.2666	32.7161	151.6939	184.410	.062331	.27033	.332661	104.1	.19197	136.1
136.2	5.33260	135.45200	2.61926	.13586	951.02	.0074376	52.0632	15.0210	3.2592	18.2802	32.7402	152.1798	184.920	.062372	.27116	.333532	104.2	.19214	136.2
136.3	5.34660	135.80960	2.62614	.13629	954.03	.0074559	52.1913	15.0235	3.2703	18.2938	32.7643	152.6657	185.430	.062413	.27199	.334403	104.3	.19231	136.3
136.4	5.36060	136.16720	2.63302	.13672	957.04	.0074742	52.3194	15.0260	3.2814	18.3074	32.7884	153.1516	185.940	.062454	.27282	.335274	104.4	.19248	136.4
136.5	5.37460	136.52480	2.63990	0.13715	960.05	0.0074925	52.4475	15.0285	3.2925	18.3210	32.8125	153.6375	186.450	0.062495	0.27363	0.336145	104.5	0.19265	136.5
136.6	5.38860	136.88240	2.64678	.13758	963.06	.0075108	52.5756	15.0310	3.3036	18.3346	32.8366	154.1234	186.960	.062536	.27448	.337016	104.6	.19282	136.6
136.7	5.40260	137.24000	2.65366	.13801	966.07	.0075291	52.7037	15.0335	3.3147	18.3482	32.8607	154.6093	187.470	.062577	.27531	.337887	104.7	.19299	136.7
136.8	5.41660	137.59760	2.66054	.13844	969.08	.0075474	52.8318	15.0360	3.3258	18.3618	32.8848	155.0952	187.980	.062618	.27614	.338758	104.8	.19316	136.8
136.9	5.43060	137.95520	2.66742	.13887	972.09	.0075657	52.9599	15.0385	3.3369	18.3754	32.9089	155.5811	188.490	.062659	.27697	.339629	104.9	.19333	136.9
137.0	5.4446	138.3128	2.6743	0.1393	975.1	0.007584	53.088	15.041	3.348	18.389	32.933	156.067	189.000	0.06270	0.2778	0.3405	105.0	0.1935	137.0
137.1	5.45892	138.67453	2.68133	.13976	978.32	.0076025	53.2175	15.0435	3.3594	18.4029	32.9571	156.5829	189.540	.06274	.27867	.34141	105.1	.19367	137.1
137.2	5.47324	139.03626	2.68836	.14022	981.54	.0076210	53.3470	15.0460	3.3708	18.4168	32.9812	157.0988	190.080	.06278	.27954	.34232	105.2	.19384	137.2
137.3	5.48756	139.39789	2.69539	.14068	984.76	.0076395	53.4765	15.0485	3.3822	18.4307	33.0053	157.6147	190.620	.06282	.28041	.34323	105.3	.19401	137.3
137.4	5.50188	139.75972	2.70242	.14114	987.98	.0076580	53.6060	15.0510	3.3936	18.4446	33.0294	158.1306	191.160	.06286	.28128	.34414	105.4	.19418	137.4
137.5	5.51620	140.12145	2.70945	0.14160	991.20	0.0076765	53.7355	15.0535	3.4050	18.4585	33.0535	158.6465	191.700	0.06290	0.28215	0.34505	105.5	0.19435	137.5
137.6	5.53052	140.48318	2.71648	.14206	994.42	.0076950	53.8650	15.0560	3.4164	18.4724	33.0776	159.1624	192.240	.06294	.28302	.34596	105.6	.19452	137.6
137.7	5.54484	140.84491	2.72351	.14252	997.64	.0077135	53.9945	15.0585	3.4278	18.4863	33.1017	159.6783	192.780	.06298	.28389	.34687	105.7	.19469	137.7
137.8	5.55916	141.20664	2.73054	.14298	1000.86	.0077320	54.1240	15.0610	3.4392	18.5002	33.1258	160.1942	193.320	.06302	.28476	.34778	105.8	.19486	137.8
137.9	5.57348	141.56837	2.73757	.14344	1004.08	.0077505	54.2535	15.0635	3.4506	18.5141	33.1499	160.7101	193.860	.06306	.28563	.34869	105.9	.19503	137.9
138.0	5.5878	141.9301	2.7446	0.1439	1007.3	0.007769	54.383	15.066	3.462	18.528	33.174	161.226	194.400	0.06310	0.28650	0.34960	106.0	0.19520	138.0
138.1	5.60244	142.30196	2.75179	.14436	1010.52	.0077815	54.5125	15.0685	3.4738	18.5423	33.198	161.752	194.950	.06314	.28739	.35053	106.1	.19537	138.1
138.2	5.61708	142.67382	2.75898	.14482	1013.74	.0078060	54.6420	15.0710	3.4856	18.5566	33.222	162.278	195.50	.06318	.28828	.35146	106.2	.19554	138.2
138.3	5.63172	143.04568	2.76617	.14528	1016.96	.0078245	54.7715	15.0735	3.4974	18.5709	33.246	162.804	196.050	.06322	.28917	.35239	106.3	.19571	138.3
138.4	5.64636	143.41754	2.77336	.14574	1020.18	.0078430	54.9010	15.0760	3.5092	18.5852	33.270	163.33	196.60	.06326	.29006	.35332	106.4	.19588	138.4
138.5	5.66100	143.78940	2.78055	0.14620	1023.4	0.0078615	55.0305	15.0785	3.5210	18.5995	33.294	163.856	197.150	0.06330	0.29095	0.35425	106.5	0.19605	138.5
138.6	5.67564	144.16126	2.78774	.14666	1026.62	.0078800	55.1600	15.0810	3.5328	18.6138	33.318	164.382	197.700	.06334	.29184	.35518	106.6	.19622	138.6
138.7	5.69028	144.53312	2.79493	.14712	1029.84	.0078985	55.2895	15.0835	3.5446	18.6281	33.342	164.908	198.250	.06338	.29273	.35611	106.7	.19639	138.7
138.8	5.70492	144.90498	2.80212	.14758	1033.06	.0079170	55.4190	15.0860	3.5564	18.6424	33.366	165.434	198.80	.06342	.29362	.35704	106.8	.19656	138.8
138.9	5.71956	145.27684	2.80931	.14804	1036.28	.0079355	55.5485	15.0885	3.5682	18.6567	33.390	165.960	199.35	.06346	.29451	.35797	106.9	.19673	138.9
139.0	5.7342	145.6487	2.8165	0.1485	1039.5	0.007954	55.678	15.091	3.580	18.671	33.414	166.486	199.90	0.06350	0.29540	0.3589	107.00	0.1969	139.0
139.1	5.74916	146.02868	2.82385	.14899	1042.93	.0079737	55.8152	15.0936	3.5922	18.6858	33.4381	167.0419	200.48	.06354	.29633	.35987	107.099	.19706	139.1
139.2	5.76412	146.40866	2.83120	.14948	1046.36	.0079934	55.9524	15.0962	3.6044	18.7006	33.4622	167.5978	201.06	.06358	.29726	.36084	107.198	.19722	139.2
139.3	5.77908	146.78864	2.83855	.14997	1049.79	.0080131	56.0896	15.0988	3.6166	18.7154	33.4863	168.1537	201.64	.06362	.29819	.36181	107.297	.19738	139.3
139.4	5.79404	147.16862	2.84590	.15046	1053.22	.0080328	56.2268	15.1014	3.6288	18.7302	33.5104	168.7096	202.22	.06366	.29912	.36278	107.396	.19754	139.4

139.5	5.80900	147.54860	2.85325	0.15095	1056.65	0.00805 25	56.3640	15.1040	3.6410	18.7450	33.5345	169.2655	202.80	0.06370	0.30005	0.36375	107.495	0.19770	139.5
139.6	5.82396	147.92858	2.86060	.15144	1060.08	.00809722	56.5012	15.1066	3.6532	18.7598	33.5586	169.8214	203.38	.06374	.30098	.36472	107.594	.19786	139.6
139.7	5.83892	148.30856	2.86795	.15193	1063.51	.00809 19	56.6384	15.1092	3.6654	18.7746	33.5827	170.3773	203.96	.06378	.30191	.36569	107.693	.19802	139.7
139.8	5.85388	148.68854	2.87530	.15242	1066.94	.00811116	56.7756	15.1118	3.6776	18.7894	33.6068	170.9332	204.54	.06382	.30284	.36666	107.792	.19818	139.8
139.9	5.86884	149.06852	2.88265	.15291	1070.37	.00813 13	56.9128	15.1144	3.6898	18.8042	33.6309	171.4891	205.12	.06386	.30377	.36763	107.891	.19834	139.9
140.0	5.8838	149.4485	2.8900	0.1534	1073.8	0.008151	57.050	15.117	3.702	18.819	33.655	172.045	205.70	0.06390	0.30470	0.36860	107.99	0.19850	140.0
140.1	5.89909	149.83687	2.89751	.1539	1077.30	.00817 09	57.191	15.1195	3.7147	18.8342	33.6791	172.6109	206.290	.06394	.30565	.36959	108.09	.19867	140.1
140.2	5.91438	150.22524	2.90502	.1544	1080.80	.00819 08	57.332	15.1220	3.7274	18.8494	33.7032	173.1768	206.880	.06398	.30660	.37058	108.19	.19884	140.2
140.3	5.92967	150.61361	2.91253	.1549	108430	.00821 07	57.473	15.1245	3.7401	18.8646	33.7273	173.7427	207.470	.06402	.30755	.37157	108.29	.19901	140.3
140.4	5.94496	151.00198	2.92004	.1554	1087.80	.00823 06	57.614	15.1270	3.7528	18.8798	33.7914	174.3086	208.060	.06406	.30850	.37256	108.39	.19918	140.4
140.5	5.96026	151.39035	2.92755	0.1559	1091.30	0.008250 5	57.755	15.1295	3.7655	18.8950	33.7755	174.8745	208.650	0.06410	0.30945	0.37356	108.49	0.19935	140.5
140.6	5.97554	151.77872	2.93506	.1564	1094.80	.00827 04	57.896	15.1320	3.7782	18.9102	33.7996	175.4404	209.240	.06414	.31040	.37454	108.59	.19952	140.6
140.7	5.99083	152.16709	2.94257	.1569	1098.30	.00829 03	58.037	15.1345	3.7909	18.9254	33.8237	176.0063	209.830	.06418	.31135	.37553	108.69	.19969	140.7
140.8	6.00612	152.55546	2.95008	.1574	1101.80	.00831 02	58.178	15.1370	3.8036	18.9406	33.8478	176.5722	210.420	.06422	.31230	.37652	108.79	.19986	140.8
140.9	6.02141	152.94383	2.95759	.1579	1105.30	.00833 01	58.319	15.1395	3.8163	18.9558	33.8719	177.1381	211.010	.06426	.31325	.37751	108.89	.20003	140.9
141.0	6.0367	153.3322	2.9651	0.1584	1108.8	0.008350	58.460	15.142	3.829	18.971	33.896	177.704	211.600	0.06430	0.31420	0.37850	108.99	0.2002	141.0
141.1	6.05233	153.72920	2.97278	.15892	1112.44	.00837 03	58.6011	15.1445	3.8422	18.9867	33.920	178.290	212.21	.06434	.31519	.37953	109.09	.20036	141.1
141.2	6.06796	154.12620	2.98046	.15944	1116.08	.00839 06	58.7422	15.1470	3.8554	19.0024	33.944	178.876	212.820	.06438	.31618	.38056	109.19	.20052	141.2
141.3	6.08359	154.52320	2.98814	.15996	1119.72	.00841 09	58.8833	15.1495	3.8686	19.0181	33.968	179.462	213.430	.06442	.31717	.38159	109.29	.20068	141.3
141.4	6.09922	154.92020	2.99582	.16048	1123.36	.00843 12	59.0244	15.1520	3.8818	19.0338	33.992	180048	214.040	.06446	.31816	.38262	109.39	.20084	141.4
141.5	6.11485	155.31726	3.00350	0.16100	1127.00	0.008451 5	59.1655	15.1545	3.8950	19.0495	34.016	180634	214.650	0.06450	0.31915	0.38365	109.49	0.20100	141.5
141.6	6.13048	155.71420	3.01118	.16152	1130.64	.00847 18	59.3066	15.1570	3.9082	19.0652	34.040	181.220	215.260	.06454	.32014	.38468	109.59	.20116	141.6
141.7	6.14611	156.11120	3.01886	.16204	1134.28	.00849 21	59.4477	15.1595	3.9214	19.0809	34.064	181.806	215870	.06458	.32113	.38571	109.69	.20132	141.7
141.8	6.16174	156.50820	3.02654	.16256	1137.92	.00851 24	59.5888	15.1620	3.9346	19.0966	34.088	182.392	216.480	.06462	.32212	.38674	109.79	.20148	141.8
141.9	6.17737	156.90520	3.03422	.16308	1141.56	.00853 27	59.7299	15.1645	3.9478	19.1123	34.112	182.9798	217.090	.06466	.32311	.38777	109.89	.20164	141.9
142.0	6.1930	157.3022	3.0419	0.1636	1145.2	0.008553	59.8710	15.167	3.961	19.128	34.136	183.564	217.700	0.06470	0.32410	0.3888	109.99	0.2018	142.0
142.1	6.20897	157.70784	3.04975	.16413	1148.91	.00857 33	60.0121	15.1695	3.9747	19.1442	34.1601	184.1799	218.34	.06474	.32512	.38986	110.09	.20197	142.1
142.2	6.22494	158.11348	3.05760	.16466	1152.62	.00859 36	60.1532	15.1720	3.9884	19.1604	34.1842	184.7958	218.98	.06478	.32614	.39092	110.19	.20214	142.2
142.3	6.24091	158.51912	3.06545	.16519	1156.33	.00861 39	60.2943	15.1745	4.0021	19.1766	34.2083	185.4117	219.62	.06482	.32716	.39198	110.29	.20231	142.3
142.4	6.25688	158.92476	3.07330	.16572	1160.04	.00863 42	60.4354	15.1770	4.0158	19.1928	34.2324	186.0276	220.26	.06486	.32818	.39304	110.39	.20248	142.4
142.5	6.27285	159.33040	3.08115	0.16625	1163.75	0.008654 5	60.5765	15.1795	4.0295	19.2090	34.2565	186.6435	220.90	0.06490	0.32920	0.39410	110.49	0.20265	142.5
142.6	6.28882	159.73604	3.08900	.16678	116746	.00867 48	60.7176	15.1820	4.0432	19.2252	34.2806	187.2594	221.54	.06494	.33022	.39516	110.59	.20282	142.6
142.7	6.30479	160.14168	3.09685	.16731	1171.17	.00869 51	60.8587	15.1845	4.0569	19.2444	34.3047	187.8753	222.18	.06498	.33124	.39622	110.69	.20299	142.7
142.8	6.32076	160.54732	3.10470	.16787	1174.88	.00871 54	60.9998	15.1870	4.0706	19.2576	34.3288	188.4912	222.82	.06502	.33226	.39728	110.79	.20316	142.8
142.9	6.33673	160.95296	3.11255	.16837	1178.59	.00873 56	61.1409	15.1895	4.0843	19.2738	34.3529	189.1071	223.46	.06506	.33328	.39834	110.89	.20333	142.9
143.0	6.3527	161.3586	3.1204	0.1689	1182.3	0.008756	61.292	15.192	4.098	19.290	34.377	189.723	224.100	0.06510	0.3343	0.3994	110.99	0.2035	143.0
143.1	6.36903	161.77338	3.12842	.16946	1186.22	.00877 73	61.4411	15.1946	4.1121	19.3067	34.4011	190.3489	224.75	.065139	.33536	.400499	111.09	.20366	143.1
143.2	6.38536	162.18816	3.13644	.17002	1190.14	.00879 86	61.5902	15.1972	4.1262	19.3234	34.4252	190.9748	225.40	.065178	.33642	.401598	111.19	.20382	143.2
143.3	6.40169	162.60294	3.14446	.17058	1194.06	.00881 99	61.7393	15.1998	4.1403	19.3401	34.4493	191.6007	226.05	.065217	.33748	.402697	111.29	.20398	143.3
143.4	6.41802	163.01772	3.15248	.17114	1197.98	.00884 12	61.8884	15.2024	4.1544	19.3568	34.4734	192.2266	226.70	.065256	.33854	.403796	111.39	.20414	143.4
143.5	6.43435	163.43250	3.16050	0.17170	1201.90	0.008862 5	62.0375	15.2050	4.1685	19.3735	34.4975	192.8525	227.35	0.065295	0.33960	0.404895	111.49	0.20430	143.5
143.6	6.45068	163.84728	3.16852	.17226	1205.82	.00888 38	62.1866	15.2076	4.1826	19.3902	34.5216	193.4784	228.00	.065334	.34066	.405994	111.59	.20446	143.6
143.7	6.46701	164.26206	3.17654	.17282	1209.74	.00890 51	62.3357	15.2102	4.1967	19.4069	34.5457	194.1043	228.65	.065373	.34172	.407093	111.69	.20462	143.7
143.8	6.48334	164.67684	3.18456	.17338	1213.66	.00892 64	62.4848	15.2128	4.2108	19.4236	34.5698	194.7302	229.30	.065412	.34278	.408192	111.79	.20478	143.8
143.9	6.49967	165.09162	3.19258	.17394	1217.58	.00894 77	62.6339	15.2154	4.2249	19.4403	34.5939	195.3561	229.950	.065451	.34384	.409291	111.89	.20494	143.9

144.0	6.5160	165.3064	3.2006	0.1745	1221.5	0.008969	62.783	15.218	4.239	19.457	34.618	195.982	230.60	0.06549	0.3449	0.41039	111.99	0.2051	144.0
144.1	6.53268	165.93007	3.20879	.17508	1225.56	.0089906	62.9342	15.2205	4.2537	19.4742	34.6421	196.6319	231.28	.06553	.3460	.41153	112.09	.20527	144.1
144.2	6.54936	166.35374	3.21698	.17566	1229.62	.0090122	63.0854	15.2230	4.2684	19.4914	34.6662	197.2938	231.96	.06557	.3471	.41267	112.19	.20544	144.2
144.3	6.56604	166.77741	3.22517	.17624	1233.68	.0090338	63.2366	15.2285	4.2831	19.5086	34.6903	197.9497	232.64	.06561	.3482	.41381	112.29	.20561	144.3
144.4	6.58272	167.20108	3.23336	.17682	1237.74	.0090554	63.3878	15.2280	4.2978	19.5258	34.7144	198.6056	233.32	.06565	.3493	.41495	112.39	.20578	144.4
144.5	6.59940	167.62475	3.24155	0.17742	1241.80	0.0090770	63.5390	15.2305	4.3125	19.5430	34.7385	199.2615	234.00	0.06569	0.3504	0.41509	112.49	0.20595	144.5
144.6	6.61608	168.04842	3.24974	.17798	1245.86	.0090986	63.6902	15.2330	4.3272	19.5602	34.7626	199.9174	234.68	.06573	.3515	.41723	112.59	.20612	144.6
144.7	6.63276	168.47209	3.25793	.17856	1249.92	.0091202	63.8414	15.2355	4.3419	19.5774	34.7867	200.5733	235.36	.06577	.3526	.4837	112.69	.20629	144.7
144.8	6.64944	168.89576	3.26612	.17914	1253.98	.0091418	63.9926	15.2380	4.3566	19.5946	34.8108	201.2292	236.04	.06581	.3537	.41951	112.79	.20646	144.8
144.9	6.66612	169.31943	3.27431	.17972	1258.04	.0091634	64.1438	15.2405	4.3713	19.6118	34.8349	201.8851	236.72	.06585	.3548	.42065	112.89	.20663	144.9
145.0	6.6828	169.7431	3.2825	0.1803	1262.1	0.009185	64.295	15.243	4.386	19.629	34.859	202.541	237.40	0.06589	0.3559	0.42179	112.99	0.2068	145.0
145.1	6.69984	170.17582	3.29087	.18089	1266.23	.0092066	64.4462	15.2455	4.4013	19.6468	34.8830	203.217	238.1	.06593	.35703	.42296	113.09	.20696	145.1
145.2	6.71688	170.60864	3.29924	.18148	1270.36	.0092282	64.5974	15.2480	4.4166	19.6646	34.907	203.893	238.8	.06597	.35816	.42413	113.19	.20712	145.2
145.3	6.73392	171.04146	3.30761	.18207	1274.49	.0092498	64.7486	15.2505	4.4319	19.6824	34.931	204.569	239.5	.06601	.35929	.42530	113.29	.20728	145.3
145.4	6.75096	171.47428	3.31598	.18266	1278.62	.0092714	64.8998	15.2530	4.4472	19.7002	34.955	205.245	240.2	.06605	.36042	.42647	113.39	.20744	145.4
145.5	6.76800	171.90710	3.32435	0.18325	1282.75	0.0092930	65.0510	15.2555	4.4625	19.7180	34.979	205.921	240.9	0.06609	0.36155	0.42764	113.49	0.20760	145.5
145.6	6.78504	172.33992	3.33272	.18384	1286.88	.0093146	65.2022	15.2580	4.4778	19.7358	35.003	206.597	241.6	.06613	.36268	.42881	113.59	.20776	145.6
145.7	6.80208	172.77274	3.34109	.18443	1291.01	.0093362	65.3545	15.2605	4.4931	19.7536	35.027	207.273	242.3	.06617	.36381	.42998	113.69	.20792	145.7
145.8	6.81912	173.20556	3.34946	.18502	1295.14	.0093578	65.5046	15.2630	4.5084	19.7714	35.051	207.949	243.0	.06621	.36494	.43115	113.79	.20828	145.8
145.9	6.83616	173.63838	3.35783	.18561	1299.27	.0093794	65.6558	15.2655	4.5237	19.7892	35.075	208.625	243.7	.06625	.36607	.43232	113.89	.20824	145.9
146.0	6.8532	174.0713	3.3662	0.1862	1303.4	0.009401	65.807	15.268	4.539	19.807	35.099	209.301	244.40	0.06629	0.3672	0.43349	113.99	0.2084	146.0
146.1	6.87061	174.51351	3.37475	.18682	1307.74	.0094233	65.9631	15.2705	4.5549	19.8254	35.1231	210.0069	245.13	.06633	.36838	.43471	114.09	.20857	146.1
146.2	6.88802	174.95572	3.38330	.18744	1312.08	.0094456	66.1192	15.2730	4.5708	19.8438	35.1472	210.7128	245.86	.06637	.36956	.43593	114.19	.20874	146.2
146.3	6.90543	175.39793	3.39185	.18806	1316.42	.0094679	66.2753	15.2755	4.5867	19.8622	35.1713	211.4187	246.59	.06641	.37074	.43715	114.29	.20891	146.3
146.4	6.92284	175.84014	3.40040	.18868	1320.76	.0094902	66.4314	15.2780	4.6026	19.8806	35.1954	212.1246	247.32	.06645	.37192	.43837	114.39	.20908	146.4
146.5	6.94023	176.28235	3.40895	0.18930	1325.10	0.009512	66.5875	15.2805	4.6185	19.8990	35.2195	212.8305	248.05	0.06649	0.37310	0.43959	114.49	0.20925	146.5
146.6	6.95766	176.72456	3.41750	.18992	1329.44	.0095348	66.7436	15.2830	4.6344	19.9174	35.2436	213.5364	248.78	.06653	.37428	.44081	114.59	.20942	146.6
146.7	6.97507	177.16677	3.42605	.19054	1333.78	.0095571	66.8997	15.2855	4.6503	19.9358	35.2677	214.2423	249.51	.06657	.37546	.44203	114.69	.20959	146.7
146.8	6.99248	177.60898	3.43460	.19116	1338.12	.0095794	67.0558	15.2880	4.6662	19.9542	35.2918	214.9482	250.24	.06661	.37664	.44325	114.79	.20976	146.8
146.9	7.00989	178.05119	3.44315	.19178	1342.46	.0096017	67.2119	15.2905	4.6821	19.9726	35.3159	215.6541	250.97	.06665	.37782	.44447	114.89	.20993	146.9
147.0	7.0273	178.4934	3.4517	0.1924	1346.8	0.009624	67.363	15.293	4.698	19.991	35.340	216.360	251.70	0.06669	0.37900	0.44569	114.99	0.2101	147.0
147.1	7.04508	178.94501	3.46043	.19305	1351.35	.0096472	67.5304	15.2956	4.7144	20.0100	35.3641	217.0959	252.46	.066729	.38022	.446949	115.09	.21026	147.1
147.2	7.06286	179.39662	3.46916	.19370	1355.90	.0096704	67.6928	15.2982	4.7308	20.0290	35.3882	217.8318	253.22	.066768	.38144	.448208	115.19	.21042	147.2
147.3	7.08064	179.84823	3.47789	.19435	1360.45	.0096936	67.8552	15.3008	4.7472	20.0480	35.4123	218.5677	253.98	.066807	.38266	.449467	115.29	.21058	147.3
147.4	7.09842	180.29984	3.48662	.19500	1365.00	.0097168	68.0176	15.3034	4.7636	20.0670	35.4364	219.3036	254.74	.066846	.38388	.450726	115.39	.21074	147.4
147.5	7.11620	180.75145	3.49535	0.19565	1369.55	0.0097400	68.1800	15.3060	4.7800	20.0860	35.4605	220.0395	255.50	0.066885	0.38510	0.451985	115.49	0.2109	147.5
147.6	7.13398	181.20306	3.50408	.19630	1374.10	.0097632	68.3424	15.3086	4.7964	20.1050	35.4846	220.7754	256.26	.066924	.38632	.453244	115.59	.21106	147.6
147.7	7.15176	181.65467	3.51281	.19695	1378.65	.0097864	68.5048	15.3112	4.8128	20.1240	35.5087	221.5113	257.02	.066963	.38754	.454503	115.69	.21122	147.7
147.8	7.16954	182.10628	3.52154	.19760	1383.20	.0098096	68.6672	15.3138	4.8292	20.1430	35.5328	222.2472	257.78	.067002	.38876	.455762	115.79	.21138	147.8
147.9	7.18732	182.55789	3.53027	.19825	1387.75	.0098328	68.8296	15.3164	4.8456	20.1620	35.5569	222.9831	258.54	.067044	.38998	.457021	115.89	.21154	147.9
148.0	7.2051	183.0095	3.5390	0.1989	1392.3	0.0098.56	68992	15.319	4.862	20.181	35.581	223.719	25930	0.06708	0.39120	0.45828	11599	0.21170	148.0
148.1	7.22326	183.47077	3.54792	.19956	1396.92	.0098796	69.1572	15.3215	4.8791	20.2006	35.6051	224.4746	260.08	.06712	.39246	.45959	116.09	.21187	148.1
148.2	7.24142	183.93204	3.55684	.20022	1401.54	.0099032	69.3224	15.3240	4.8962	20.2202	35.6292	225.2308	260.86	.06716	.39372	.46088	116.19	.21204	148.2
148.3	7.25958	184.39331	3.56576	.20088	1406.16	.0099268	69.4876	15.3265	4.9133	20.2398	35.6533	225.9867	261.64	.06720	.39498	.46218	116.29	.21221	148.3
148.4	7.27774	184.85458	3.57468	.20154	1410.78	.0099504	69.6528	15.3290	4.9304	20.2594	35.6774	226.7426	262.42	.06724	.39624	.46348	116.39	.21238	148.4

148.5	7.29590	185.31585	3.58360	0.20220	1415.4	0.0099740	69.8180	15.3315	4.9475	20.2790	35.7015	227.4985	263.20	0.06728	0.39750	0.46478	116.49	0.21255	148.5
148.6	7.31406	185.77712	3.59252	.20286	1420.02	.0099976	69.9832	15.3340	4.9646	20.2986	35.7256	228.2544	263.98	.06732	.39876	.46608	116.59	.21272	148.6
148.7	7.33222	186.23839	3.60144	.20352	1424.64	.0100212	70.1484	15.3365	4.9817	20.3182	35.7497	229.0103	264.76	.06736	.40002	.46738	116.69	.21289	148.7
148.8	7.35038	186.69966	3.61036	.20428	1429.26	.0100448	70.3136	15.3390	4.9988	20.3378	35.7738	229.7662	265.54	.06740	.40128	.46868	116.79	.21306	148.8
148.9	7.36854	187.16093	3.61928	.20484	1433.88	.0100684	70.4788	15.3415	5.0159	20.3574	35.7979	230.5221	266.32	.06744	.40254	.46998	116.89	.21323	148.9
149.0	7.3867	187.6222	3.6282	0.2055	1438.5	0.0100092	70.644	15.344	5.033	20.377	35.822	231.278	267.10	0.06748	0.4038	0.47128	116.99	0.2134	149.0
149.1	7.40525	188.09337	3.63732	.20620	1443.4	.01011600	70.812	15.3465	5.0508	20.3973	35.8461	232.0739	267.92	.067519	.40511	.472629	117.09	.21356	149.1
149.2	7.42380	188.56454	3.64644	.20690	1448.3	.010140	70.980	15.3490	5.0686	20.4176	35.8702	232.8698	268.74	.067558	.40642	.473978	117.19	.21372	149.2
149.3	7.44235	189.03571	3.65356	.20760	1453.2	.010164	71.148	15.3515	5.0864	20.4379	35.8943	233.6657	269.56	.067597	.40773	.475327	117.29	.21388	149.3
149.4	7.46090	189.50688	3.66468	.20830	1458.1	.010188	71.316	15.3540	5.1042	20.4582	35.9184	234.4616	270.38	.067636	.40904	.476676	117.39	.21404	149.4
149.5	7.47945	189.97805	3.67380	0.2090	1463.0	0.010212	71.484	15.3565	5.1220	20.4785	35.9425	235.2575	271.20	0.067675	0.41035	0.478025	117.49	0.2142	149.5
149.6	7.49800	190.44922	3.68292	.20970	1467.9	.010236	71.652	15.3590	5.1398	20.4988	35.9666	236.0534	272.02	.067714	.41166	.479374	117.59	.21436	149.6
149.7	7.51655	190.92039	3.69204	.21040	1472.8	.010260	71.820	15.3615	5.1576	20.5191	35.9907	236.8493	272.84	.067753	.41297	.480723	117.69	.21452	149.7
149.8	7.53510	191.39156	3.70116	.21110	1477.7	.010284	71.988	15.3640	5.1754	20.5394	36.0148	237.6452	273.66	.067792	.41428	.482072	117.79	.21468	149.8
149.9	7.55365	191.86273	3.71028	.21180	1482.6	.010308	72.156	15.3665	5.1932	20.5597	36.0389	238.4411	274.48	.067831	.41559	.483421	117.89	.21484	149.9
150.0	7.5722	192.3339	3.7194	0.2125	1487.5	0.010332	72.324	15.369	5.211	20.580	36.063	239.237	275.30	0.06787	0.4169	0.48477	117.99	0.2150	150.0
150.1	7.59114	192.81497	3.72870	.21322	1492.54	.0103564	72.4948	15.3715	5.2295	20.6010	36.0871	240.0429	276.13	.06791	.41825	.48616	118.09	.21517	150.1
150.2	7.61008	193.29604	3.73800	.21394	1497.58	.0103808	72.6656	15.3740	5.2480	20.6220	36.1112	240.8488	276.96	.06795	.41960	.48755	118.19	.21534	150.2
150.3	7.62902	193.77711	3.74730	.21466	1502.62	.0104052	72.8364	15.3765	5.2665	20.6430	36.1353	241.6547	277.79	.06799	.42095	.48894	118.29	.21551	150.3
150.4	7.64796	194.25818	3.75660	.21538	1507.66	.0104296	73.0072	15.3790	5.2850	20.6640	36.1594	242.4606	278.62	.06803	.42230	.49033	118.39	.21568	150.4
150.5	7.66690	194.73925	3.76590	0.21610	1512.70	0.0104546	73.1780	15.3815	5.3035	20.6850	36.1835	243.2665	279.45	0.06807	0.42365	0.49172	118.49	0.21585	150.5
150.6	7.68584	195.22032	3.77520	.21682	1517.74	.0104784	73.3488	15.3840	5.3220	20.7060	36.2076	244.0724	280.28	.06811	.42500	.49311	118.59	.21602	150.6
150.7	7.70478	195.70139	3.78450	.21754	1522.78	.0105028	73.5196	15.3865	5.3405	20.7270	36.2317	244.8783	281.11	.06815	.42635	.49450	118.69	.21619	150.7
150.8	7.72372	196.18246	3.79380	.21826	1527.82	.0105272	73.6904	15.3890	5.3590	20.7480	36.2558	245.6842	281.94	.06819	.42770	.49589	118.79	.21636	150.8
150.9	7.74266	196.66353	3.80310	.21898	1532.86	.0105516	73.8612	15.3915	5.3775	20.7690	36.2799	246.4901	282.77	.06823	.42905	.49728	118.89	.21653	150.9
151.0	7.7616	197.1446	3.8124	0.2197	1537.9	0.010576	74.032	15.394	5.396	20.790	36.304	247.296	283.60	0.06827	0.4304	0.49867	118.99	0.21670	151.0
151.1	7.78094	197.63584	3.82190	.22044	1543.08	.0106004	74.2028	15.3966	5.4451	20.8117	36.3281	248.1519	284.48	.068309	.43181	.500119	119.09	.21686	151.1
151.2	7.80028	198.12708	3.83140	.22118	1548.26	.0106248	74.3736	15.3992	5.4342	20.8334	36.3522	249.0078	285.36	.068348	.43322	.501568	119.19	.21702	151.2
151.3	7.81962	198.61832	3.84090	.22192	1553.44	.0106492	74.5444	15.4018	5.4533	20.8551	36.3763	249.8637	286.24	.068387	.43463	.503017	119.29	.21718	151.3
151.4	7.83896	199.10956	3.85040	.22266	1558.62	.0106736	74.7152	15.4044	5.4723	20.8768	36.4004	250.7196	287.12	.068426	.43604	.504466	119.39	.21734	151.4
151.5	7.85830	199.60080	3.85990	0.22340	1563.8	0.0106980	74.8860	15.4070	5.4915	20.8985	36.4252	251.5755	288.00	0.068465	0.43745	0.505915	119.49	0.21750	151.5
151.6	7.87764	200.09204	3.86940	.22414	1568.98	.0107224	75.0568	15.4096	5.5106	20.9202	36.4486	252.4314	288.88	.068504	.43886	.507364	119.59	.21766	151.6
151.7	7.89698	200.58328	3.87890	.22488	1574.16	.0107468	75.2276	15.4122	5.5297	20.9419	36.4727	253.2873	289.76	.068543	.44027	.508813	119.69	.21782	151.7
151.8	7.91632	201.07452	3.88840	.22562	1579.34	.0107712	75.3984	15.4148	5.5488	20.9636	36.4968	254.1432	290.64	.068582	.44168	.510262	119.79	.21798	151.8
151.9	7.93566	201.56576	3.89790	.22636	1584.52	.0107956	75.5692	15.4174	5.5679	20.9853	36.5209	254.9991	291.52	.068621	.44309	.511711	119.89	.21814	151.9
152.0	7.9550	202.0570	3.9074	0.2271	1589.7	0.010820	75.740	15.420	5.587	21.007	36.545	255.855	292.40	0.06866	0.4445	0.51316	119.99	0.2183	152.0
152.1	7.97475	202.55865	3.91710	.22788	1595.06	.0108449	75.9143	15.4225	5.6071	21.0296	36.569	256.7410	293.31	.06870	.44596	.51466	120.09	.21847	152.1
152.2	7.99450	203.06030	3.92680	.22866	1600.42	.0108698	76.0886	15.4250	5.6272	21.0522	36.593	257.6277	294.22	.06874	.44742	.51616	120.19	.21864	152.2
152.3	8.01425	203.56195	3.93650	.22944	1605.78	.0108947	76.2629	15.4275	5.6473	21.0748	36.617	258.513	295.13	.06878	.44888	.51766	120.29	.21881	152.3
152.4	8.03400	204.06360	3.94620	.23022	1611.14	.0109196	76.4372	15.4300	5.6674	21.0974	36.641	259.399	296.04	.06882	.45034	.51916	120.39	.21898	152.4
152.5	8.05375	204.56525	3.95590	0.23100	1616.50	0.0109445	76.6115	15.4325	5.6875	21.1200	36.665	260.285	296.95	0.06886	0.45180	0.52066	120.49	0.21915	152.5
152.6	8.07350	205.06690	3.96560	.23178	1621.86	.0109694	76.7858	15.4350	5.7076	21.1426	36.689	261.171	297.86	.06890	.45326	.52216	120.59	.21932	152.6
152.7	8.09325	205.56855	3.97530	.23256	1627.22	.0109943	76.9601	15.4375	5.7277	21.1652	36.713	262.057	298.77	.06894	.45472	.52366	120.69	.21949	152.7
152.8	8.11300	206.07020	3.98500	.23334	1632.58	.0110192	77.1344	15.4400	5.7478	21.1878	36.737	262.943	299.68	.06898	.45618	.52516	120.79	.21966	152.8
152.9	8.13275	206.57185	3.99470	.23412	1637.94	.0110441	77.3087	15.4425	5.7679	21.2104	36.761	263.829	300.59	.06902	.45764	.52666	120.89	.21983	152.9

153.0	8.1525	207.0735	4.00044	0.2349	1644.3	0.011069	77.483	15.445	5.788	21.233	36.785	264.715	301.500	0.069906	0.45910	0.52816	120.99	0.2200	153.0
153.1	8.172266	207.58556	4.01431	.23571	1649.97	.0110946	77.66622	15.4475	5.8088	21.2563	36.8091	265.6309	302.44	.069099	.46062	.529719	121.09	.22016	153.1
153.2	8.192882	208.09762	4.02422	.23652	1655.64	.0111202	77.8414	15.4500	5.8296	21.2796	36.8332	266.5468	303.38	.069138	.46214	.531278	121.19	.22032	153.2
153.3	8.212798	208.60968	4.03413	.23733	1661.31	.0111458	78.0206	15.4525	5.8504	21.3029	36.8573	267.4627	304.32	.069177	.46366	.532837	121.29	.22048	153.3
153.4	8.233314	209.12174	4.04404	.23814	1666.98	.0111714	78.1998	15.4550	5.8712	21.3262	36.8814	268.3786	305.26	.069216	.46518	.534396	121.39	.22064	153.4
153.5	8.253530	209.63380	4.05395	0.23895	1672.65	0.011197	78.3790	15.4575	5.8920	21.3495	36.9055	269.2945	306.20	0.069255	0.46670	0.535955	121.49	0.22080	153.5
153.6	8.273446	210.14586	4.06386	.23976	1678.32	.011226	78.5582	15.4600	5.9128	21.3728	36.9296	270.2104	307.14	.069294	.46822	.537514	121.59	.22096	153.6
153.7	8.293062	210.65792	4.07377	.24057	1683.99	.0112482	78.7374	15.4625	5.9336	21.3961	36.9537	271.1263	308.08	.069333	.46974	.539073	121.69	.22112	153.7
153.8	8.312378	211.16998	4.08368	.24138	1689.66	.0112738	78.9166	15.4650	5.9544	21.4194	36.9778	272.0422	309.02	.069372	.47126	.540632	121.79	.22128	153.8
153.9	8.331394	211.68204	4.09359	.24219	1695.33	.0112994	79.0958	15.4675	5.9752	21.4417	37.0019	272.9581	310.96	.069411	.47278	.542191	121.89	.22144	153.9
154.0	8.3541	212.1941	4.10350	0.2430	1701.0	0.011325	79.275	15.470	5.996	21.466	37.026	273.874	310.90	0.06945	0.4743	0.54375	121.99	0.22160	154.0
154.1	8.374468	212.71664	4.11361	.24384	1706.88	.0113510	79.457	15.4726	6.0177	21.4908	37.0501	274.8399	311.89	.069489	.47588	.545389	122.09	.22176	154.1
154.2	8.394526	213.23918	4.12372	.24468	1712.76	.0113770	79.639	15.4752	6.0394	21.5146	37.0742	275.8058	312.88	.069528	.47746	.546988	122.19	.22192	154.2
154.3	8.414584	213.76172	4.13383	.24552	1718.64	.0114030	79.821	15.4778	6.0611	21.5389	37.0983	276.7717	313.87	.069567	.47904	.548607	122.29	.22208	154.3
154.4	8.433642	214.28426	4.14394	.24636	1724.52	.0114290	80.003	15.4804	6.0828	21.5632	37.1224	277.7376	314.86	.069606	.48062	.550226	122.39	.22224	154.4
154.5	8.4570	214.80680	4.15405	0.24720	1730.40	0.011455O	80.185	15.4830	6.1045	21.5875	37.1465	278.7035	315.85	0.069645	0.48220	0.551845	122.49	0.2224	154.5
154.6	8.477758	215.32934	4.16416	.24804	1736.28	.0114810	80.367	15.4856	6.1262	21.6118	37.1706	279.6694	316.84	.069684	.48378	.553464	122.59	.22256	154.6
154.7	8.497816	215.85188	4.17427	.24888	1742.16	.0115070	80.549	15.4882	6.1479	21.6361	37.1947	280.6353	317.83	.069723	.48536	.555083	122.69	.22272	154.7
154.8	8.517874	216.37442	4.18438	.24972	1748.04	.0115330	80.731	15.4908	6.1696	21.6604	37.2188	2866012	318.82	.069762	.48694	.556702	122.79	.22288	154.8
154.9	8.537932	216.89696	4.19449	.25056	1753.92	.0115590	80.913	15.4934	6.1913	21.6847	37.2429	282.5671	319.81	.069801	.48852	.558321	122.89	.22304	154.9
155.0	8.5599	217.4195	4.2046	0.2514	1759.8	0.011585	81.095	15.496	6.213	21.709	37.267	283.533	320.80	0.06984	0.4901	0.55994	122.99	0.2232	155.0
155.1	8.580692	217.95360	4.21492	.25228	1765.96	.0116115	81.2805	15.4985	6.2356	21.7341	37.2911	284.5289	321.82	.069879	.49175	.561629	123.09	.22336	155.1
155.2	8.60194	218.48770	4.22524	.25316	1772.12	.011638	81.4660	15.5010	6.2582	21.7592	37.3152	285.5248	322.84	.069918	.49340	.563318	123.19	.22352	155.2
155.3	8.622296	219.02180	4.23556	.25404	1778.28	.0116645	81.6515	15.5035	6.2808	21.7843	37.3393	286.5207	323.86	.069957	.49505	.565007	123.29	.22368	155.3
155.4	8.643398	219.55590	4.24588	.25492	1784.44	.0116910	81.8370	15.5060	6.3034	21.8094	37.3634	287.5166	324.88	.069996	.49670	.566696	123.39	.22384	155.4
155.5	8.6650	220.090	4.25620	0.25580	1790.60	0.011717S	82.0225	15.5085	6.3260	21.8345	37.3875	288.5125	325.90	0.070035	0.49835	0.568385	123.49	0.2240	155.5
155.6	8.686602	220.62410	4.26652	.25668	1796.76	.011744	82.2080	15.5110	6.3486	21.8596	37.4116	289.5084	326.92	.070074	.50000	.570074	123.59	.22446	155.6
155.7	8.707004	221.15820	4.27684	.25756	1802.92	.0117705	82.3935	15.5135	6.3712	21.8847	37.4357	290.5043	327.94	.070113	.50165	.571763	123.69	.22432	155.7
155.8	8.726806	221.69230	4.28716	.25844	1809.08	.0117970	82.5790	15.5160	6.3938	21.9098	37.4598	291.5002	328.96	.070152	.50330	.573452	123.79	.22448	155.8
155.9	8.746908	222.22640	4.29748	.25932	1815.24	.0118235	82.7645	15.5185	6.4164	21.9349	37.4839	292.4961	329.98	.070191	.50495	.575141	123.89	.22464	155.9
156.0	8.7701	222.7605	4.3078	0.2602	1824.4	0.01185	82.95	15.521	6.439	21.960	37.508	293.492	331.00	0.07023	0.5066	0.57683	123.99	0.2248	156.0
156.1	8.79155	223.30533	4.31834	.26111	1827.77	.011877	83.1390	15.5235	6.4626	21.9861	37.5327	294.5379	332.07	.070269	.50831	.578579	124.09	.22497	156.1
156.2	8.81300	223.85016	4.32888	.26202	1834.14	.011904	83.328	15.5260	6.4862	22.0122	37.5562	295.5838	333.14	.070308	.51002	.580328	124.19	.22514	156.2
156.3	8.83445	224.39499	4.33942	.26293	1840.51	.011931	83.517	15.5285	6.5098	22.0383	37.5803	296.6297	334.21	.070347	.51173	.582077	124.29	.22531	156.3
156.4	8.85590	224.93982	4.34996	.26384	1846.88	.011958	83.706	15.5310	6.5334	22.0644	37.6044	297.6756	335.28	.070386	.51344	.583826	124.39	.22548	156.4
156.5	8.87735	225.48465	4.36050	0.26475	1853.25	0.011985	83.895	15.5335	6.5570	22.0905	37.6285	298.7215	336.35	0.070425	0.51515	0.585575	124.49	0.22565	156.5
156.6	889880	226.02948	4.37104	.26566	1859.62	.012012	84.084	15.5360	6.5806	22.1166	37.6526	299.7674	337.42	.070464	.51686	.587324	124.59	.22582	156.6
156.7	8.92025	226.57431	4.38158	.26657	1865.99	.012039	84.273	15.5385	6.6042	22.1427	37.6767	300.8133	338.49	.070503	.51857	.589073	124.69	.22599	156.7
156.8	8.94170	227.11914	4.39212	.26748	1872.36	.012066	84.462	15.5410	6.6278	22.1688	37.7008	301.8592	339.56	.070542	.52028	.590822	124.79	.22616	156.8
156.9	8.96315	227.66397	4.40266	.26839	1878.73	.012093	84.651	15.5435	6.6514	22.1949	37.7249	302.9051	340.63	.070581	.52199	.592571	124.89	.22633	156.9
157.0	8.9846	228.2083	4.41332	0.2693	1885.1	0.01242	84.84	15.546	6.675	22.221	37.249	303.951	341.70	0.07062	0.52370	0.59432	124.99	0.2265	157.0
157.1	9.00650	228.76506	4.42395	.27025	1891.75	.012475	85.0325	15.5485	6.6997	22.2482	37.7731	305.0269	342.8	.070659	.52548	.596139	125.09	.22666	157.1
157.2	9.02840	229.32132	4.43470	.27120	1898.40	.012175	85.2250	15.5510	6.7244	22.2754	37.7972	306.1028	343.9	.070698	.52726	.597958	125.19	.22682	157.2
157.3	9.05030	229.87758	4.44545	.27215	1905.05	.0122025	85.4175	15.5535	6.7491	22.3026	37.8213	307.1787	345.0	.070737	.52904	.599777	125.29	.22698	157.3
157.4	9.07220	230.43384	4.45620	.27310	1911.70	.0122300	85.6100	15.5560	6.7738	22.3298	37.8454	308.2546	346.1	.070776	.53082	.601596	125.39	.22714	157.4

157.5	9.09410	230.99010	4.46695	0.27405	1918.35	0.0122575	85.8025	15.5585	6.7985	22.3570	37.8695	309.3305	347.2	0.070815	0.53260	0.603415	125.49	0.22730	157.5
157.6	9.11600	231.54636	4.47770	.27501	1925.00	.0122285	85.9950	15.5610	6.8232	22.3842	37.8936	310.4064	348.3	.070854	.53438	.605234	125.54	.22746	157.6
157.7	9.13790	232.10262	4.48845	.27595	1931.65	.0123125	86.1875	15.5635	6.8479	22.4114	37.9177	311.4823	349.4	.070893	.53616	.607053	125.69	.22762	157.7
157.8	9.15980	232.65888	4.49920	.27690	1938.30	.012340	86.3800	15.5660	6.8726	22.4386	37.9418	312.5582	350.5	.070932	.53794	.608872	125.79	.22778	157.8
157.9	9.18170	233.21514	4.50995	.27785	1944.95	.0123675	86.5725	15.5685	6.8973	22.4658	37.9659	313.6341	351.6	.070971	.53972	.610691	125.89	.22794	157.9
158.0	9.20360	233.77114	4.52057	0.2788	1951.6	0.012395	86.765	15.5711	6.922	22.493	37.990	314.710	352.7	0.07101	0.5415	0.61251	125.99	0.22810	158.0
158.1	9.22595	234.33907	4.53167	.27979	1958.53	.012423	86.961	15.5736	6.9476	22.5212	38.0141	315.8359	353.85	.071049	.54335	.614399	126.091	.22826	158.1
158.2	9.24830	234.90674	4.54264	.28078	1965.46	.012451	87.157	15.5762	6.9732	22.5494	38.0382	316.9618	355.0	.071088	.54520	.616288	126.192	.22842	158.2
158.3	9.27065	235.47441	4.55361	.28177	1972.39	.012479	87.353	15.5788	6.9988	22.5776	38.0632	318.0877	356.15	.071127	.54705	.618177	126.293	.22858	158.3
158.4	9.29300	236.04208	4.56458	.28276	1979.32	.012507	87.549	15.5814	7.0244	22.6058	38.0864	319.2136	357.30	.071166	.5489	.620066	126.394	.22874	158.4
158.5	9.31535	236.60975	4.57555	0.28375	1986.25	0.012535	87.745	15.5840	7.0500	22.6340	38.1105	320.3395	358.45	0.071205	0.55075	0.621955	126.445	0.22890	158.5
158.6	9.33770	237.17742	4.58652	.28474	1993.18	.012563	87.941	15.5866	7.0756	22.6622	38.1346	321.4654	359.60	.071244	.55260	.623844	126.596	.22906	158.6
158.7	9.36005	237.74509	4.59749	.28573	2000.11	.012591	88.137	15.5892	7.1012	22.6904	38.1587	322.5913	360.75	.071282	.55445	.625733	126.697	.22922	158.7
158.8	9.38240	238.31276	4.60846	.28672	2007.04	.012619	88.333	15.5918	7.1268	22.7186	38.1828	323.7172	361.90	.071322	.55630	.627622	126.798	.22938	158.8
158.9	9.40475	238.88043	4.61943	.28771	2013.97	.012647	88.529	15.5944	7.1524	22.7468	38.2069	324.8431	363.05	.071361	.55815	.629511	126.899	.22954	158.9
159.0	9.4271	239.4481	4.6304	0.2887	2020.9	0.012675	88.725	15.597	7.178	22.775	38.231	325.969	364.20	0.07140	0.5600	0.65140	129.00	0.2297	159.0
159.1	9.44995	240.02951	4.6416	.28973	2028.11	.0127035	88.9245	15.5995	7.2048	22.8043	38.2551	327.1549	365.41	.071439	.56193	.633369	127.1	.22986	159.1
159.2	9.47280	240.61092	4.6528	.29076	2035.32	.012732	89.1240	15.6020	7.2316	22.8336	38.2792	328.3408	366.62	.071478	.56386	.635338	127.2	.23002	159.2
159.3	9.49565	241.19233	4.6640	.29179	2042.53	.0127605	89.3235	15.6045	7.2584	22.8629	38.3033	329.5267	367.83	.071517	.56579	.637307	127.3	.23018	159.3
159.4	9.51850	241.77374	4.6752	.29282	2049.74	.012789	89.5230	15.6070	7.2852	22.8922	38.3274	330.7126	369.04	.071556	.56772	.638276	127.4	.23034	159.4
159.5	9.54135	242.35515	4.6864	0.29385	2056.95	0.0128175	89.7225	15.6095	7.3120	22.9215	38.3515	331.8985	370.25	0.071595	0.56965	0.641245	127.5	0.23050	159.5
159.6	9.56420	242.93656	4.6976	.29488	2064.16	.012846	89.9220	15.6120	7.3388	22.9508	38.3756	333.0844	371.46	.071634	.57158	.643214	127.6	.23066	159.6
159.7	9.58705	243.51797	4.7088	.29591	2071.37	.0128745	90.1215	15.6145	7.3656	22.9801	38.3997	334.2703	372.67	.071673	.57351	.645183	127.7	.23082	159.7
159.8	9.60990	244.09938	4.7200	.29694	2078.58	.012903	90.3210	15.6170	7.3924	23.0094	38.4238	335.4562	373.88	.071712	.57544	.647152	127.8	.23098	159.8
159.9	9.63275	244.68079	4.7312	.29797	2085.79	.0129315	90.5205	15.6195	7.4192	23.0387	38.4479	336.6421	375.09	.071751	.57737	.649121	127.9	.23114	159.9
160.0	9.6056	245.2622	4.7424	0.2990	2093.0	0.01296	90.72	15.622	7.446	23.068	38.472	337.828	376.3	0.071740	0.5793	0.651090	128.0	0.23130	160.0
160.1	9.67880	245.85048	4.75382	.30008	2100.5	.012989	90.923	15.6245	7.4741	23.0986	38.4961	339.0539	377.55	.071829	.58131	.653139	128.1	.23146	160.1
160.2	9.70200	246.43876	4.76524	.30116	2108.0	.013018	91.126	15.6270	7.5022	23.1292	38.5202	340.2798	378.80	.071868	.58332	.655188	128.2	.23162	160.2
160.3	9.72520	247.02704	4.77666	.30224	2115.5	.013047	91.329	15.6295	7.5303	23.1598	38.5443	341.5057	380.05	.071907	.58533	.656237	128.3	.23178	160.3
160.4	9.74840	247.61532	4.78808	.30332	2123.0	.013076	91.532	15.6320	7.5584	23.1904	38.5684	342.7316	381.30	.071946	.58734	.659286	128.4	.23194	160.4
160.5	9.77160	248.20839	4.79935	0.30440	2130.5	0.013105	91.735	15.6345	7.5865	23.2210	38.5925	343.9575	382.55	0.071985	0.58935	0.661335	128.5	0.23210	160.5
160.6	9.79480	248.79187	4.81092	.30548	2138.0	.013134	91.938	15.6370	7.6146	23.2516	38.6166	345.1834	383.80	.072024	.59136	.663384	128.6	.23226	160.6
160.7	9.81800	249.38015	4.82234	.30656	2145.5	.013163	92.141	15.6395	7.6427	23.2822	38.6407	346.4093	385.05	.072063	.59337	.665433	128.7	.23242	160.7
160.8	9.84120	249.96844	4.83376	.30764	2153.0	.013192	92.344	15.6420	7.6708	23.3128	38.6648	347.6352	386.30	.072102	.59538	.667482	128.8	.23258	160.8
160.9	9.86440	250.55672	4.84518	.30872	2160.5	.013221	92.547	15.6445	7.6989	23.3434	38.6889	348.8611	387.55	.072141	.59739	.669531	128.9	.23274	160.9
161.0	9.8876	251.1450	4.8566	0.3098	2168.6	0.01325	92.75	15.647	7.727	23.374	38.713	350.087	388.8	0.07218	0.5994	0.67158	129.0	0.2329	161.0
161.1	9.91134	251.74800	4.86826	.31093	2176.51	.01328	92.96	15.6495	7.7563	23.4058	38.7371	351.3829	390.12	.072219	.6015	.673719	129.1	.23306	161.1
161.2	9.93508	252.35100	4.87992	.31206	2184.42	.01331	93.17	15.6520	7.7856	23.4376	38.7612	352.6788	391.44	.072258	.6036	.675858	129.2	.23322	161.2
161.3	9.95882	252.95400	4.89158	.31319	2192.33	.01334	93.38	15.6545	7.8149	23.4694	38.7853	353.9747	392.76	.072297	.6057	.677997	129.3	.23338	161.3
161.4	9.98256	253.55700	4.90324	.31432	2200.24	.01337	93.59	15.6570	7.8442	23.5012	38.8094	355.2706	394.08	.072336	.6078	.680136	129.4	.23354	161.4
161.5	10.00630	254.16000	4.91490	0.31545	2208.15	0.01340	93.80	15.6595	7.8735	23.5330	38.8335	356.5665	395.40	0.072375	0.6099	0.682275	129.5	0.23370	161.5
161.6	10.03004	254.76300	4.92656	.31658	2216.06	.01343	94.01	15.6620	7.9028	23.5648	38.8576	357.8624	396.72	.072414	.6120	.684414	129.6	.23386	161.6
161.7	10.05378	255.36600	4.93822	.31771	2223.97	.01346	94.22	15.6645	7.9321	23.5966	38.8817	359.1583	398.04	.072453	.6141	.686553	129.7	.23402	161.7
161.8	10.07752	255.96900	4.94988	.31884	2231.88	.01349	94.43	15.6670	7.9614	23.6284	38.9058	360.4542	399.36	.072492	.6162	.688692	129.8	.23418	161.8
161.9	10.10126	256.57200	4.96154	.31997	2239.79	.01352	94.64	15.6695	7.9907	23.6602	38.9299	361.7501	400.68	.072531	.6183	.690831	129.9	.23434	161.9

162.0	10.125	257.1750	4.9732	0.3211	2247.7	0.01355	94.85	15.672	8.020	23.692	38.954	363.046	402.00	0.07257	0.6704	0.69297	130.0	0.2345	162.0
162.1	10.1492	257.78968	4.98509	.32228	2255.96	.013581	95.067	15.6746	8.0506	23.7252	38.9781	364.3919	403.37	.072609	.6725	.695199	130.1	.23466	162.1
162.2	10.1734	258.40436	4.99698	.32346	2264.22	.013612	95.284	15.6772	8.0812	23.7584	39.0022	365.7378	404.74	.072648	.6247	.697428	130.2	.23482	162.2
162.3	10.1976	259.01904	5.00887	.32464	2272.48	.013643	95.501	15.6798	8.1118	23.7916	39.0263	367.0837	406.11	.072687	.6269	.695657	130.3	.23498	162.3
162.4	10.2218	259.63372	5.02076	.32582	2280.74	.013674	95.718	15.6824	8.1424	23.8248	39.0504	368.4296	407.48	.072726	.6291	.701886	130.4	.23514	162.4
162.5	10.2460	260.24840	5.03265	0.32700	2289.00	0.013705	95.935	15.6850	8.1730	23.8580	39.0745	369.7755	408.85	0.072765	0.6313	0.704115	130.5	0.23530	162.5
162.6	10.2702	260.86308	5.04454	.32818	2297.26	.013736	96.152	15.6876	8.2036	23.8912	39.0986	371.1214	410.22	.072804	.6335	.706344	130.6	.23546	162.6
162.7	10.2944	261.47776	5.05643	.32936	2305.52	.013767	96.369	15.6902	8.2342	23.9244	39.1227	372.4673	411.59	.072843	.6357	.708573	130.7	.23562	162.7
162.8	10.3186	262.09244	5.06832	.33054	2313.78	.013798	96.586	15.6928	8.2648	23.9576	39.1468	373.8132	412.96	.072882	.6379	.710802	130.8	.23578	162.8
162.9	10.3428	262.70712	5.08021	.33172	2322.04	.013829	96.803	15.6954	8.2954	23.9908	39.1709	375.1591	414.33	.072921	.6401	.713031	130.9	.23594	162.9
163.0	10.367	263.3218	5.0921	0.3329	2330.3	0.01386	97.02	15.698	8.326	24.024	39.195	376.505	415.7	0.072960	0.6423	0.715268	131.0	0.2361	163.0
163.1	10.3917	263.94818	5.10423	.33473	2338.91	.01389	97.23	15.7005	8.3582	24.0587	39.2191	377.9009	417.12	.072998	.6445	.717588	131.1	.23626	163.1
163.2	10.4164	264.57456	5.11636	.33536	2347.52	.01392	97.44	15.7030	8.3904	24.0934	39.2432	379.2968	418.54	.073036	.6468	.719916	131.2	.23642	163.2
163.3	10.4411	265.20094	5.12849	.33659	2356.13	.01395	97.65	15.7055	8.4226	24.1281	39.2673	380.6927	419.96	.073074	.6491	.722244	131.3	.23658	163.3
163.4	10.4658	265.82732	5.14062	.33782	2364.74	.01398	97.86	15.7080	8.4548	24.1628	39.2914	382.0886	421.38	.073112	.6514	.724572	131.4	.23674	163.4
163.5	10.4905	266.45370	5.15275	0.33905	2373.35	0.01401	98.07	15.7105	8.4870	24.1975	39.3155	383.4845	422.80	0.073150	0.6537	0.726900	131.5	0.23690	163.5
163.6	10.5152	267.08008	5.16488	.34028	2381.96	.01404	98.28	15.7130	8.5192	24.2322	39.3396	384.8804	424.22	.073188	.6560	.729228	131.6	.23706	163.6
163.7	10.5399	267.70646	5.17701	.34851	2390.57	.01407	98.49	15.7155	8.5514	24.2669	39.3637	386.2763	425.64	.073226	.6583	.731556	131.7	.23722	163.7
163.8	10.5646	268.33284	5.18914	.34274	2399.18	.01410	98.70	15.7180	8.5836	24.3016	39.3878	387.6722	427.06	.073264	.6606	.733884	131.8	.23738	163.8
163.9	10.5893	268.95922	5.20127	.34397	2407.79	.01413	98.91	15.7205	8.6158	24.3363	39.4119	389.0681	428.48	.073302	.6629	.736212	131.9	.23754	163.9
164.0	10.614	269.5856	5.2134	0.3452	2416.4	0.01416	99.12	15.723	8.648	24.371	39.436	390.464	429.9	0.07334	0.6652	0.73854	132.0	0.2377	164.0
164.1	10.6392	270.22668	5.22578	.34649	2425.43	.014192	99.344	15.7255	8.6817	24.4072	39.4601	391.9499	431.41	.073579	.6676	.740979	132.1	.23786	164.1
164.2	10.6644	270.86776	5.23816	.34778	2434.46	.014224	99.568	15.7280	8.7154	24.4434	39.4842	393.4858	432.92	.073618	.6700	.743418	132.2	.23802	164.2
164.3	10.6896	271.50884	5.25054	.34907	2443.49	.014256	99.792	15.7305	8.7491	24.4796	39.5083	394.9217	434.43	.073657	.6724	.745857	132.3	.23818	164.3
164.4	10.7148	272.14992	5.26292	.35036	2452.52	.014288	100.016	15.7330	8.7828	24.5158	39.5324	396.4076	435.94	.073696	.6748	.748296	132.4	.23834	164.4
164.5	10.7400	272.79100	5.27530	0.35165	2461.55	0.01432	100.240	15.7355	8.8165	24.5520	39.5565	397.8935	437.45	0.073535	0.6772	0.750735	132.5	0.23850	164.5
164.6	10.7652	273.43208	5.28768	.35294	2470.58	.014352	100.464	15.7380	8.8502	24.5882	39.5806	399.3784	438.96	.073574	.6796	.753174	132.6	.23866	164.6
164.7	10.7904	274.07316	5.30006	.35423	2479.61	.014384	100.688	15.7405	8.8839	24.6244	39.6047	400.8653	440.47	.073613	.6820	.755613	132.7	.23882	164.7
164.8	10.8156	274.71424	5.31244	.35552	2488.64	.014416	100.912	15.7430	8.9176	24.6606	39.6288	402.3512	441.98	.073652	.6844	.758052	132.8	.23898	164.8
164.9	10.8408	275.35532	5.32482	.35681	2497.67	.014448	101.136	15.7455	8.9513	24.6968	39.6529	403.8371	443.49	.073691	.6868	.760491	132.9	.23914	164.9
165.0	10.866	275.9964	5.3372	0.3581	2506.7	0.01448	101.36	15.748	8.985	24.733	39.677	405.323	445.0	0.07373	0.6892	0.76293	133.0	0.2393	165.0
165.1	10.8917	276.64918	5.34982	.35945	2516.15	.014512	101.584	15.7505	9.0204	24.7709	39.7011	406.8689	446.57	.073768	.6917	.765468	133.1	.23946	165.1
165.2	10.9174	277.30196	5.36244	.36080	2525.60	.014544	101.808	15.7530	9.0558	24.8088	39.7252	408.4148	448.14	.073806	.6942	.768006	133.2	.23962	165.2
165.3	10.9431	277.95474	5.37506	.36215	2535.05	.014576	102.032	15.7555	9.0917	24.8467	39.7493	409.9607	449.71	.073844	.6967	.770544	133.3	.23978	165.3
165.4	10.9688	278.60752	5.38768	.36350	2544.50	.014608	102.256	15.7580	9.1266	24.8846	39.7734	411.5066	451.28	.073882	.6992	.773082	133.4	.23994	165.4
165.5	10.9945	279.26030	5.40030	0.36485	2553.95	0.014640	102.480	15.7605	9.1620	24.9225	39.7975	413.0525	452.85	0.073920	0.7017	0.775620	133.5	0.24010	165.5
165.6	11.0202	279.91308	5.41292	.36620	2563.40	.014672	102.704	15.7630	9.1974	24.9604	39.8216	414.5984	454.42	.073958	.7042	.778158	133.6	.24026	165.6
165.7	11.0459	280.56586	5.42554	.36755	2572.85	.014704	102.928	15.7655	9.2328	24.9983	39.8457	416.1443	455.99	.073996	.7067	.780696	133.7	.24042	165.7
165.8	11.0716	281.21864	5.43816	.36890	2582.30	.014736	103.152	15.7680	9.2682	25.0362	39.8698	417.6902	457.56	.074034	.7092	.783234	133.8	.24058	165.8
165.9	11.0973	281.87142	5.45078	.37025	2591.75	.014768	103.376	15.7705	9.3036	25.0741	39.8939	419.2361	459.13	.074072	.7117	.785772	133.9	.24074	165.9
166.0	11.123	282.5242	5.4634	0.3716	2601.2	0.01480	103.60	15.773	9.339	25.112	39.918	420.782	460.7	0.07411	0.7142	0.788310	134.0	0.2409	166.0
166.1	11.1492	283.18968	5.47627	.37302	2611.14	.014833	103.831	15.7756	9.3759	25.1515	39.9421	422.4079	462.35	.074149	.7168	.790979	134.101	.24107	166.1
166.2	11.1754	283.85516	5.48914	.37444	2621.08	.014866	104.062	15.7782	9.4128	25.1910	39.9662	424.0336	464.00	.074188	.7194	.793648	134.202	.24124	166.2
166.3	11.2016	284.52064	5.50201	.37586	2631.02	.014899	104.293	15.7808	9.4497	25.2305	39.9903	425.6597	465.65	.074227	.7220	.796317	134.303	.24141	166.3
166.4	11.2278	285.18612	5.51488	.37728	2640.96	.014932	104.524	15.7834	9.4866	25.2700	40.0144	427.2856	467.30	.074266	.7247	.798986	134.404	.24158	166.4

166.5	11.2540	285.85160	5.52775	0.37870	2650.9	0.014965	104.755	15.7860	9.5235	25.3095	40.0385	428.9115	468.95	0.074305	0.72735	0.801655	134.505	0.24175	166.5
166.6	11.2802	286.51708	5.54062	.38012	2660.84	.014998	104.986	15.7886	9.5604	25.3490	40.0626	430.5374	470.60	.074344	.72998	.804324	134.606	.24192	166.6
166.7	11.3064	287.18256	5.55349	.38154	2670.78	.015031	105.217	15.7912	9.5973	25.3885	40.0867	432.1633	472.25	.074383	.73261	.806593	134.707	.24209	166.7
166.8	11.3326	287.84804	5.56636	.38296	2680.72	.015064	105.448	15.7938	9.6342	25.4280	40.1108	433.7892	473.90	.074422	.73524	.809662	134.808	.24226	166.8
166.9	11.3588	288.51352	5.57923	.38438	2690.66	.015097	105.679	15.7964	9.6711	25.4675	40.1349	435.4151	475.55	.074461	.73787	.812331	134.909	.24243	166.9
167.0	11.385	289.1790	5.5921	0.3858	2700.6	0.01513	105.91	15.799	9.708	25.507	40.159	437.041	477.2	0.07450	0.7405	0.8150	135.01	0.2426	167.0
167.1	11.4117	289.85718	5.60522	.38729	2711.03	.015163	106.141	15.8015	9.747	25.5485	40.1831	438.7369	478.92	.074538	.74325	.817788	135.11	.24275	167.1
167.2	11.4384	290.53536	5.61834	.38878	2721.46	.015196	106.372	15.8040	9.786	25.5900	40.2072	440.4328	480.64	.074576	.74600	.820576	135.21	.24290	167.2
167.3	11.4651	291.21354	5.63146	.39027	2731.89	.015229	106.603	15.8065	9.825	25.6315	40.2313	442.1287	482.36	.074614	.74875	.823364	135.31	.24305	167.3
167.4	11.4918	291.89172	5.64458	.39176	2742.32	.015262	106.834	15.8090	9.864	25.6730	40.2554	443.8246	484.08	.074652	.7515o	.826152	135.41	.24320	167.4
167.5	11.5185	292.56990	5.65770	0.39325	2752.75	0.015295	107.065	15.8115	9.903	25.7145	40.2795	445.5205	485.80	0.074690	0.75425	0.828940	135.51	0.24335	167.5
167.6	11.5452	293.24808	5.67082	.39474	2763.18	.015328	107.296	15.8140	9.942	25.7560	40.3036	447.2164	487.52	.074728	.75700	.831728	135.61	.24350	167.6
167.7	11.5719	293.92626	5.68394	.39623	2773.61	.015361	107.527	15.8165	9.981	25.7975	40.3277	448.9123	489.24	.074766	.75975	.834516	135.71	.24365	167.7
167.8	11.5986	294.60444	5.69706	.39772	2784.04	.015394	107.758	15.8190	10.020	25.8390	40.3518	450.6082	490.96	.074804	.76250	.837304	135.81	.24380	167.8
167.9	11.6253	295.28262	5.71618	.39921	2794.47	.015427	107.989	15.8215	10.159	25.8850	40.3759	452.3041	492.68	.074842	.76525	.840092	135.91	.24395	167.9
168.0	11.652	295.9608	5.7233	0.4007	2804.9	0.01546	108.22	15.824	10.098	25.922	40.406	454.000	494.4	0.07488	0.7680	0.84288	136.01	0.2441	168.0
168.1	11.6793	296.65422	5.73609	.40226	2815.82	.015493	108.451	15.8265	10.139	25.9655	40.4241	455.7759	496.20	.074919	.77089	.845809	136.11	.24426	168.1
168.2	11.7066	297.34764	5.75008	.40382	2826.74	.015526	108.682	15.8290	10.180	26.0090	40.4482	457.5518	498.00	.074958	.77378	.848738	136.21	.24442	168.2
168.3	11.7339	298.04106	5.76347	.40538	2837.66	.015559	108.913	15.8315	10.221	26.0525	40.4723	459.3277	499.8	.074997	.77667	.851867	136.31	.24458	168.3
168.4	11.7612	298.73448	5.77686	.40694	2848.58	.015592	109.144	15.8340	10.262	26.0960	40.4964	461.1036	501.6	.075036	.77956	.854596	136.41	.24474	168.4
168.5	11.7885	299.42790	5.79025	0.40850	2859.50	0.015625	109.375	15.8365	10.303	26.1395	40.5205	462.8795	503.4	0.075075	0.78245	0.857525	136.51	0.24490	168.5
168.6	11.8158	300.12132	5.80364	.41006	2870.42	.015658	109.606	15.8390	10.344	26.1830	40.5446	464.6554	505.2	.075114	.78534	.860454	136.61	.24506	168.6
168.7	11.8431	300.81474	5.81703	.41162	2881.34	.015691	109.837	15.8415	10.385	26.2265	40.5687	466.4313	507.0	.075153	.78823	.863383	136.71	.24522	168.7
168.8	11.8704	301.50816	5.83042	.41318	2892.26	.015724	110.068	15.8440	10.426	26.2700	40.5928	468.2072	508.8	.075192	.79112	.866312	136.81	.24538	168.8
168.9	11.8977	302.20158	5.84381	.41474	2903.18	.015757	110.299	15.8465	10.467	26.3135	40.6169	469.9831	510.6	.075231	.79401	.869241	136.91	.24554	168.9
169.0	11.925	302.8950	5.8572	0.4163	2914.1	0.01579	110.53	15.849	10.508	26.357	40.641	471.759	512.4	0.07527	0.7969	0.87217	137.01	0.2457	169.0
169.1	11.9528	303.60112	5.87084	.41794	2925.58	.015825	110.775	15.8515	10.551	26.4025	40.6651	473.6449	514.31	.075308	.79994	.875248	137.11	.24586	169.1
169.2	11.9806	304.30724	5.88448	.41958	2937.06	.015860	111.020	15.8540	10.594	26.4480	40.6892	475.5308	516.22	.075346	.80298	.878326	137.21	.24602	169.2
169.3	12.0084	305.01336	5.89817	.42122	2948.54	.015895	111.265	15.8565	10.637	26.4935	40.7133	477.4167	518.13	.075384	.80602	.881404	137.31	.24618	169.3
169.4	12.0362	305.71948	5.91176	.42286	2960.02	.015930	111.510	15.8590	10.680	26.5390	40.7374	479.3026	520.04	.075422	.80906	.884482	137.41	.24634	169.4
169.5	12.0640	306.42560	5.92540	0.42450	2971.50	0.015965	111.755	15.8615	10.723	26.5845	40.7615	481.1885	521.95	0.075460	0.81210	0.887560	137.51	0.24650	169.5
169.6	12.0918	307.13172	5.93904	.42614	2982.98	.016000	112.000	15.8640	10.766	26.6300	40.7856	483.0744	523.86	.075498	.81514	.890638	137.61	.24666	169.6
169.7	12.1196	307.83784	5.95268	.42778	2994.46	.016035	112.245	15.8665	10.809	26.6755	40.8097	484.9603	525.77	.075536	.81818	.893716	137.71	.24682	169.7
169.8	12.1474	308.54396	5.96632	.42942	3005.94	.016070	112.490	15.8690	10.852	26.7210	40.8338	486.8462	527.68	.075574	.82122	.896794	137.81	.24698	169.8
169.9	12.1752	309.25008	5.97996	.43106	3017.42	.016105	112.735	15.8715	10.895	26.7665	40.8579	488.7321	529.59	.075612	.82426	.899872	137.91	.24714	169.9
170.0	12.203	309.9562	5.9936	0.43271	3028.9	0.01614	112.98	15.874	10.938	26.812	40.882	490.618	531.5	0.07565	0.8273	0.90295	138.01	0.2473	170.0
170.1	12.2313	310.67502	6.00752	.43443	3041.01	.016175	113.225	15.8766	10.9833	26.8599	40.9061	492.5939	533.5	.075688	.83049	.906178	138.11	.24746	170.1
170.2	12.2596	311.39384	6.02144	.43616	3053.12	.016210	113.470	15.8792	11.0286	26.9078	40.9302	494.5698	535.5	.075726	.83368	.909406	138.21	.24762	170.2
170.3	12.2879	312.11266	6.03536	.43789	3065.23	.016245	113.715	15.8818	11.0739	26.9557	40.9543	496.5457	537.5	.075764	.83687	.912634	138.31	.24778	170.3
170.4	12.3162	312.83148	6.04928	.43962	3077.34	.016280	113.960	15.8844	11.1192	27.0036	40.9784	498.5216	539.5	.075802	.84006	.915868	138.41	.24794	170.4
170.5	12.3445	313.55030	6.06320	0.44135	3089.45	0.016315	114.205	15.8870	11.1645	27.0515	41.0025	500.4975	541.5	0.075840	0.84325	0.919090	138.51	0.24810	170.5
170.6	12.3728	314.26917	6.07712	.44308	3101.51	.016350	114.450	15.8896	11.2098	27.1994	41.0266	502.4734	543.5	.075878	.84644	.922318	138.61	.24826	170.6
170.7	12.4011	314.98754	6.09104	.44481	3113.67	.016385	114.695	15.8922	11.2551	27.1473	41.0507	504.4493	545.5	.075916	.84963	.925546	138.71	.24842	170.7
170.8	12.4294	315.70676	6.10496	.44654	3125.78	.016420	114.940	15.8948	11.3004	27.1952	41.0748	506.4252	547.5	.075954	.85282	.928774	138.81	.24858	170.8
170.9	12.4577	316.42558	6.11888	.44827	3127.89	.016455	115.185	15.8974	11.3457	27.2431	41.0989	508.4011	549.5	.075992	.85601	.932002	138.91	.24874	170.9

171.0	12.486	317.1444	6.1328	0.4580	3150.0	0.01649	115.43	15.900	11.391	27.291	41.123	510.377	551.5	0.07603	0.8592	0.93523	139.01	0.2489	171.0
171.1	12.5149	317.87846	6.14698	.45182	3162.74	.016525	115.675	15.9025	11.4389	27.3414	41.1471	512.4729	553.62	.076068	.86255	.935618	139.11	.24906	171.1
171.2	12.5438	318.61252	6.16116	.45364	3175.48	.016560	115.920	15.9050	11.4868	27.3918	41.1712	514.5688	555.74	.076106	.86590	.942006	139.21	.24922	171.2
171.3	12.5727	319.34668	6.17534	.45546	3188.22	.016595	116.165	15.9075	11.5347	27.4422	41.1953	516.6147	557.86	.076144	.86925	.945394	139.31	.24938	171.3
171.4	12.6016	320.08074	6.18952	.45728	3200.96	.016630	116.410	15.9100	11.5826	27.4926	41.2194	518.7606	559.98	.076182	.87260	.948782	139.41	.24954	171.4
171.5	12.6305	320.81480	6.20370	0.45910	3213.70	0.016665	116.655	15.9125	11.6305	27.5430	41.2435	520.8565	562.10	0.076220	0.87595	0.952170	139.51	0.24970	171.5
171.6	12.6594	321.54886	6.21788	.46092	3226.44	.016700	116.900	15.9150	11.6784	27.5934	41.2676	522.9524	564.22	.076258	.87930	.955558	139.61	.24986	171.6
171.7	12.6883	322.28292	6.23206	.46274	3239.18	.016735	117.145	15.9175	11.7263	27.6438	41.2917	525.0483	566.34	.076296	.88265	.958946	139.71	.25002	171.7
171.8	12.7172	323.01698	6.24624	.46456	3251.92	.016770	117.390	15.9200	11.7742	27.6942	41.3158	527.1442	568.46	.076334	.88600	.962334	139.81	.25018	171.8
171.9	12.7461	323.75104	6.26042	.46638	3264.66	.016805	117.635	15.9225	11.8221	27.7446	41.3399	529.2401	570.58	.076372	.88935	.965622	139.91	.25034	171.9
172.0	12.775	324.4850	6.2746	0.4682	3277.4	0.01684	117.88	15.925	11.870	27.795	41.364	531.536	572.7	0.07641	0.8927	0.96911	140.01	0.2505	172.0
172.1	12.8044	325.23176	6.28906	.47013	3290.91	.016877	118.139	15.9275	11.9206	27.8481	41.3881	533.5319	574.92	.076449	.89624	.972689	140.11	.25066	172.1
172.2	12.8338	325.97852	6.30352	.47206	3304.42	.016914	118.398	15.9300	11.9712	27.9012	41.4122	535.7278	577.14	.076488	.89978	.976268	140.21	.25082	172.2
172.3	12.8632	326.72528	6.31798	.47399	3317.93	.016951	118.657	15.9325	12.0218	27.9543	41.4363	537.9237	579.36	.076527	.90332	.979847	140.31	.25098	172.3
172.4	12.8926	327.47204	6.33244	.47592	3331.44	.016988	118.916	15.9350	12.0724	28.0074	41.4604	540.1196	581.58	.076566	.90686	.983426	140.41	.25114	172.4
172.5	12.9220	328.21880	6.34690	0.47785	3344.95	0.017025	119.175	15.9375	12.1230	28.0605	41.4845	542.3155	583.80	0.076605	0.91045	0.987005	140.51	0.25130	172.5
172.6	12.9514	328.96556	6.36136	.47978	3358.46	.017062	119.434	15.9400	12.1736	28.1136	41.5086	544.5114	586.02	.076644	.91394	.990584	140.61	.25146	172.6
172.7	12.9808	329.71232	6.37582	.48171	3371.97	.017099	119.693	15.9425	12.2242	28.1667	41.5327	546.7073	588.24	.076683	.91748	.994163	140.71	.25162	172.7
172.8	13.0102	330.45908	6.39028	.48364	3385.48	.017136	119.952	15.9450	12.2748	28.2198	41.5568	548.9032	590.46	.076722	.92102	.997742	140.81	.25178	172.8
172.9	13.0396	331.20584	6.40474	.48557	3398.99	.017173	120.211	15.9475	12.3254	28.2729	41.5809	551.0991	592.68	.076761	.92456	1.001321	140.91	.25194	172.9
173.0	13.069	331.9526	6.4192	0.4875	3412.5	0.01721	120.47	15.950	12.376	28.326	41.605	553.295	594.9	0.07680	0.9281	1.0049	141.01	0.2521	173.0
173.1	13.099	332.7146	6.43394	.48953	3426.71	.017247	120.729	15.9525	12.4295	28.3820	41.6291	555.6109	597.24	.076838	.93183	1.008668	141.111	.25226	173.1
173.2	13.129	333.4766	6.44868	.49156	3440.92	.017284	120.988	15.9550	12.4830	28.438	41.6532	557.9268	599.58	.076876	.93556	1.012436	141.212	.25242	173.2
173.3	13.159	334.2386	6.46342	.49359	3455.13	.017321	121.247	15.9575	12.5365	28.494	41.6773	560.2427	601.92	.076914	.93929	1.016204	141.313	.25258	173.3
173.4	13.189	335.0006	6.47816	.49562	3469.34	.017358	121.506	15.9600	12.5900	28.550	41.7014	562.5586	604.26	.076952	.94302	1.019972	141.414	.25274	173.4
173.5	13.219	335.7626	6.4929	0.49765	3483.55	0.017395	121.765	15.9625	12.6435	28.606	41.7255	564.8745	606.60	0.076990	0.94675	1.023740	141.515	0.25290	173.5
173.6	13.249	336.5246	6.50764	.49968	3497.76	.017432	122.024	15.9650	12.6970	28.662	41.7496	567.1904	608.94	.077028	.95048	1.027508	141.616	.25306	173.6
173.7	13.279	337.2866	6.52238	.50171	3511.97	.017469	122.283	15.9675	12.7505	28.718	41.7737	569.5063	611.28	.077066	.95421	1.031276	141.717	.25322	173.7
173.8	13.309	338.0486	6.53712	.50374	3526.18	.017506	122.542	15.9700	12.8040	28.774	41.7978	571.8222	613.62	.077104	.95794	1.035044	141.818	.25338	173.8
173.9	13.339	338.8106	6.55186	.50577	3540.39	.017543	122.801	15.9725	12.8575	28.830	41.8219	574.1381	615.96	.077142	.96167	1.038812	141.919	.25354	173.9
174.0	13.369	339.5726	6.5666	0.5078	3554.6	0.01758	123.06	15.975	12.911	28.886	41.846	576.454	618.3	0.07718	0.9654	1.04258	142.02	0.2537	174.0
174.1	13.3996	340.34984	6.58162	.50994	3569.58	.017617	123.319	15.9776	12.9674	28.945	41.8701	578.9199	620.79	.077218	.96936	1.046578	142.12	.25386	174.1
174.2	13.4302	341.12708	6.59664	.51208	3584.56	.017654	123.578	15.9802	13.0238	29.004	41.8942	581.3858	623.28	.077256	.97332	1.050576	142.22	.25402	174.2
174.3	13.4608	341.90432	6.61166	.51422	3599.54	.017691	123.837	15.9828	13.0802	29.063	41.9183	583.8517	625.77	.077294	.97728	1.054574	142.32	.25418	174.3
174.4	13.4914	342.68156	6.62668	.51636	3614.52	.017728	124.096	15.9854	13.1366	29.122	41.9424	586.3176	628.26	.077332	.98124	1.058572	142.42	.25434	174.4
174.5	13.5220	343.45880	6.6417	0.51858	3629.50	0.017765	124.355	15.9880	13.1930	29.181	41.9665	588.7835	630.75	0.077370	0.98525	1.062570	142.52	0.25452	174.5
174.6	13.5526	344.23604	6.65672	.52064	3644.48	.017802	124.614	15.9906	13.2494	29.240	41.9906	591.2494	633.24	.077408	.98916	1.066568	142.62	.25460	174.6
174.7	13.5832	345.01328	6.67174	.52278	3659.46	.017839	124.873	15.9932	13.3058	29.299	42.0147	593.7153	635.73	.077446	.99312	1.070566	142.72	.25482	174.7
174.8	13.6138	345.79052	6.68676	.52492	3674.44	.017876	125.132	15.9958	13.3622	29.358	42.0388	596.1812	638.22	.077484	.99708	1.074564	142.82	.25498	174.8
174.9	13.6444	346.56776	6.70178	.52706	3689.42	.017913	125.391	15.9984	13.4186	29.417	42.0629	598.6471	640.71	.077522	1.00104	1.078562	142.92	.25514	174.9
175.0	13.675	347.3450	6.7168	0.5292	3704.4	0.01795	125.65	16.001	13.475	29.476	42.087	601.113	643.2	0.07756	1.0050	1.08256	143.02	0.2553	175.0
175.1	13.7062	348.13748	6.73211	.53147	3720.29	.017989	125.923	16.0035	13.5349	29.5384	42.1111	603.7089	645.82	.077598	1.0092	1.087798	143.12	.25545	175.1
175.2	13.7374	348.92996	6.74742	.53374	3736.18	.018028	126.196	16.0060	13.5948	29.6008	42.1352	606.3048	648.44	.077636	1.0134	1.091036	143.22	.25560	175.2
175.3	13.7686	349.72244	6.76273	.53601	3752.07	.018067	126.469	16.0085	13.6547	29.6632	42.1593	608.9007	651.06	.077674	1.0176	1.095274	143.32	.25575	175.3
175.4	13.7998	350.51492	6.77804	.53828	3767.96	.018106	126.742	16.0110	13.7146	29.7256	42.1834	611.4966	653.68	.077712	1.0218	1.099512	143.42	.25590	175.4

175.5	13.8310	351.30740	6.79335	0.54055	3783.85	0.018145	127.015	16.0135	13.7745	29.7880	42.2075	614.0925	656.30	0.077750	1.0260	1.103750	143.52	0.25605	175.5
175.6	13.8622	352.09988	6.80866	.54287	3799.74	.018184	127.288	16.0160	13.8344	29.8504	42.2316	616.6884	658.92	.077788	1.0302	1.107988	143.62	.25620	175.6
175.7	13.8934	352.89236	6.82397	.54509	3815.63	.018223	127.561	16.0185	13.8943	29.9128	42.2557	619.2843	661.54	.077826	1.0344	1.112226	143.72	.25635	175.7
175.8	13.9246	353.68484	6.83928	.54736	3831.52	.018262	127.834	16.0210	13.9542	29.9752	42.2798	621.8802	664.16	.077864	1.0386	1.116464	143.82	.25650	175.8
175.9	13.9558	354.47732	6.85459	.54963	3847.41	.018301	128.107	16.0235	14.0141	30.0376	42.3039	624.4761	666.78	.077902	1.0428	1.120702	143.92	.25665	175.9
176.0	13.987	355.2698	6.8699	0.5519	3863.3	0.01834	128.38	16.026	14.074	30.100	42.328	627.072	669.4	0.07794	1.047	1.12494	144.02	0.2568	176.0
176.1	14.0187	356.07498	6.8855	.55431	3880.17	.018379	128.653	16.0285	14.1376	30.1661	42.3521	629.8879	672.19	.077978	1.0514	1.129378	144.12	.25696	176.1
176.2	14.0504	356.88016	6.9011	.55672	3897.04	.018418	128.926	16.0310	14.2012	30.2322	42.3762	632.6038	674.98	.078016	1.0558	1.133916	144.22	.25712	176.2
176.3	14.0821	357.68534	6.9167	.55913	3913.91	.018457	129.199	16.0335	14.2648	30.2983	42.4003	635.3697	677.77	.078054	1.0602	1.138254	144.32	.25728	176.3
176.4	14.1138	358.49052	6.9323	.56154	3930.78	.018496	129.472	16.0360	14.3284	30.3644	42.4244	638.1356	680.56	.078092	1.0646	1.142692	144.42	.25744	176.4
176.5	14.1455	359.29570	6.9479	0.56395	3947.65	0.018535	129.745	16.0385	14.3920	30.4305	42.4485	640.9015	683.35	0.078130	1.0690	1.147130	144.52	0.25760	176.5
176.6	14.1772	360.10088	6.9635	.56636	3964.52	.018574	130.018	16.0410	14.4556	30.4966	42.4726	643.6674	686.14	.078168	1.0734	1.151568	144.62	.25776	176.6
176.7	14.2084	360.90606	6.9791	.56877	3981.39	.018613	130.291	16.0435	14.5192	30.5627	42.4967	646.4333	688.93	.078206	1.0778	1.156006	144.72	.25792	176.7
176.8	14.2406	361.71124	6.9947	.57118	3998.26	.018652	130.564	16.0460	14.5828	30.6288	42.5208	649.1992	691.72	.078244	1.0822	1.160444	144.82	.25808	176.8
176.9	14.2723	362.51642	7.0103	.57359	4015.13	.018691	130.837	16.0485	14.6464	30.6949	42.5449	651.9651	694.51	.078282	1.0866	1.164882	144.92	.25824	176.9
177.0	14.304	363.3216	7.0259	0.5760	4032.0	0.01873	131.111	16.051	14.710	30.761	42.569	654.731	697.3	0.07832	1.091	1.169320	145.02	0.25840	177.0
177.1	14.3364	364.14456	7.0418	.57856	4049.92	.018769	131.383	16.0535	14.7776	30.8311	42.5931	657.6669	700.26	.078358	1.0956	1.173958	145.121	.25856	177.1
177.2	14.3688	364.96752	7.0577	.58112	4067.84	.018808	131.656	16.0560	14.8452	30.9012	42.6172	660.6028	703.22	.078396	1.1002	1.178596	145.222	.25872	177.2
177.3	14.4012	365.79048	7.0736	.58368	4085.76	.018847	131.929	16.0585	14.9128	30.9713	42.6413	663.5387	706.18	.078434	1.1048	1.183234	145.323	.25888	177.3
177.4	14.4336	366.61344	7.0895	.58624	4103.68	.018866	132.202	16.0610	14.9804	31.0414	42.6654	666.4746	709.14	.078472	1.1094	1.187872	145.424	.25904	177.4
177.5	14.4660	367.43640	7.1054	0.58880	4121.60	0.018925	132.475	16.0635	15.0480	31.1414	42.6895	669.4105	712.10	0.078510	1.1140	1.192510	145.525	0.25920	177.5
177.6	14.4984	368.25936	7.1213	.59136	4139.52	.018964	132.748	16.0660	15.1156	31.1816	42.7136	672.3464	715.06	.078548	1.1186	1.197148	145.626	.25936	177.6
177.7	14.5308	369.08232	7.1372	.59392	4157.44	.019003	133.021	16.0685	15.1832	31.2517	42.7377	675.2823	718.02	.078586	1.1232	1.201786	145.727	.25952	177.7
177.8	14.5632	369.90528	7.1531	.59648	4175.36	.019042	133.294	16.0710	15.2508	31.3218	42.7618	678.2182	720.98	.078624	1.1278	1.206424	145.828	.25968	177.8
177.9	14.5956	370.72824	7.1690	.59904	4193.28	.019081	133.567	16.0735	15.3184	31.3919	42.7859	681.1541	723.94	.078662	1.1324	1.211062	145.929	.25984	177.9
178.0	14.628	371.5512	7.1849	0.6016	4211.2	0.01912	133.84	16.076	15.386	31.462	42.810	684.090	726.9	0.07870	1.137	1.21570	146.03	0.2600	178.0
178.1	14.661	372.3893	7.2011	.60432	4230.24	.01916	134.122	16.0786	15.4578	31.5364	42.8341	687.2059	730.04	.078738	1.1472	1.220738	146.13	.26016	178.1
178.2	14.694	373.2274	7.2173	.60704	4249.28	.01920	134.404	16.0812	15.5296	31.6108	42.8582	690.3218	733.18	.078776	1.1517	1.225776	146.23	.26032	178.2
178.3	14.727	374.0655	7.2335	.60976	4268.32	.01924	134.686	16.0838	15.6014	31.6852	42.8823	693.4377	736.32	.078814	1.1562	1.230814	146.33	.26048	178.3
178.4	14.760	374.9036	7.2497	.61248	4287.36	.01928	134.968	16.0864	15.6732	31.7596	42.9064	696.5536	739.46	.078852	1.1607	1.235852	146.43	.26064	178.4
178.5	14.793	375.7417	7.2659	0.61520	4306.40	0.01932	135.250	16.0890	15.7450	31.8340	42.9305	699.6695	742.60	0.078890	1.1652	1.240890	146.53	0.26080	178.5
178.6	14.826	376.5798	7.2821	.61792	4325.44	.01936	135.532	16.0916	15.8168	31.9084	42.9546	702.7854	745.74	.078928	1.1697	1.245928	146.63	.26096	178.6
178.7	14.859	377.4179	7.2983	.62064	4344.48	.01940	135.814	16.0942	15.8886	31.9828	42.9787	705.9013	748.88	.078966	1.1742	1.250966	146.73	.26112	178.7
178.8	14.892	378.2560	7.3145	.62336	4363.52	.01944	136.096	16.0968	15.9604	32.0572	43.0028	709.0172	752.02	.079004	1.177	1.256004	146.83	.26128	178.8
178.9	14.925	379.0941	7.3307	.62608	4382.56	.01948	136.378	16.0994	16.0322	32.1316	43.0269	712.1331	755.16	.079042	1.182	1.261042	146.93	.26144	178.9
179.0	14.958	379.9322	7.3469	0.6288	4401.6	0.01952	136.66	16.102	16.104	32.206	43.051	715.249	758.3	0.07908	1.187	1.26608	147.03	0.2616	179.0
179.1	14.9916	380.78574	7.3634	.6317	4421.9	.019562	136.959	16.1045	16.1806	32.2851	43.0751	718.5749	761.65	.079118	1.1923	1.271418	147.13	.26175	179.1
179.2	15.0252	381.63928	7.3799	.6346	4442.2	.019604	137.258	16.1070	16.2572	32.3642	43.0992	721.9008	765.00	.079156	1.1976	1.276756	147.23	.26190	179.2
179.3	15.0585	382.49282	7.3964	.6375	4462.5	.019646	137.557	16.1095	16.3338	32.4433	43.1233	725.2267	768.35	.079194	1.2029	1.282094	147.33	.26205	179.3
179.4	15.0924	383.34636	7.4129	.6404	4482.8	.019688	137.856	16.1120	16.4104	32.5224	43.1474	728.5526	771.70	.079232	1.2082	1.287432	147.43	.26220	179.4
179.5	15.1260	384.19990	7.4294	0.6433	4503.1	0.019730	138.155	16.1145	16.4870	32.6015	43.1715	731.8785	775.05	0.079270	1.2135	1.292770	147.53	0.26235	179.5
179.6	15.1596	385.05344	7.4459	.6462	4523.4	.019772	138.454	16.1170	16.5636	32.6806	43.1956	735.2044	778.40	.079308	1.2188	1.298108	147.63	.26250	179.6
179.7	15.1932	385.90638	7.4624	.6491	4543.7	.019814	138.753	16.1195	16.6402	32.7597	43.2197	738.5303	781.75	.079346	1.2241	1.303446	147.73	.26265	179.7
179.8	15.2268	386.76052	7.4789	.6520	4564.0	.019856	139.052	16.1220	16.7168	32.8388	43.2438	741.8562	785.10	.079384	1.2294	1.308784	147.83	.26280	179.8
179.9	15.2604	387.61406	7.4954	.6549	4584.3	.019898	139.351	16.1245	16.7934	32.9179	43.2679	745.1821	788.45	.079422	1.2347	1.313122	147.93	.26295	179.9

180.0	15.294	388.4676	7.5119	0.6578	4604.6	0.01994	139.65	16.127	16.870	32.997	43.292	748.508	791.8	0.079466	1.2403	1.319466	148.03	0.2631	180.0
180.1	15.3282	389.33628	7.52872	.66089	4626.23	.019981	139.93	16.1295	16.9515	33.0814	43.3162	753.0438	795.36	.079498	1.2456	1.325098	148.13	.26326	180.1
180.2	15.3624	390.20496	7.54554	.66398	4647.86	.020022	140.21	16.1320	17.0338	35.1658	43.3404	757.5796	798.92	.079536	1.2512	1.330736	148.23	.26342	180.2
180.3	15.3966	391.07364	7.56236	.66707	4669.49	.020063	140.49	16.1345	17.1157	35.2502	43.3646	762.1154	802.48	.079574	1.2568	1.336374	148.33	.26358	180.3
180.4	15.4308	391.94232	7.57918	.67016	4691.12	.020104	140.77	16.1370	17.1976	33.3346	43.3888	766.6512	806.04	.079612	1.2624	1.343012	148.43	.26374	180.4
180.5	15.4650	392.81100	7.59600	0.67325	4712.75	0.020145	141.05	16.1395	17.2795	33.4190	43.4130	771.1870	809.60	0.079650	1.2680	1.347650	148.53	0.26390	180.5
180.6	15.4992	393.67968	7.61282	.67634	4734.38	.020186	141.33	16.1420	17.3614	33.5034	43.4372	775.7228	813.16	.079688	1.2736	1.353288	148.63	.26406	180.6
180.7	15.5334	394.54836	7.62964	.67943	4756.01	.020227	141.61	16.1445	17.4433	33.5878	43.9614	780.2586	816.72	.079726	1.2792	1.358926	148.73	.26422	180.7
180.8	15.5676	395.41704	7.64646	.68252	4777.64	.020268	141.89	16.1470	17.5252	33.6722	43.4856	784.7944	820.28	.079764	1.2848	1.364564	148.83	.26438	180.8
180.9	15.6018	396.28572	7.66328	.68561	4799.27	.020309	142.17	16.1495	17.6071	33.7566	43.5098	789.3302	823.84	.079802	1.2904	1.370202	148.93	.26454	180.9
181.0	15.636	397.1544	7.6801	0.6887	4820.9	0.02035	142.45	16.152	17.689	33.841	43.534	783.866	827.4	0.07984	1.296	1.37584	149.03	0.2647	181.0
181.1	15.6709	398.04086	7.69723	.69201	4844.07	.020393	142.751	16.1545	17.7766	33.9311	43.5581	787.6719	831.23	.079877	1.3021	1.381977	149.131	.26485	181.1
181.2	15.7058	398.92732	7.71436	.69532	4867.24	.020436	142.052	16.1570	17.8642	34.0212	43.5822	791.4778	835.06	.079914	1.3082	1.388114	149.232	.26500	181.2
181.3	15.7407	399.81378	7.73149	.69863	4890.41	.020479	143.353	16.1595	17.9518	34.1113	43.6063	795.2837	838.89	.079951	1.3143	1.394251	149.333	.26515	181.3
181.4	15.7756	400.70024	7.74862	.70194	4913.58	.020522	143.654	16.1620	18.0394	34.2014	43.6304	799.0896	842.72	.079988	1.3204	1.400388	149.434	.26530	181.4
181.5	15.8105	401.58670	7.76575	0.70528	4936.75	0.020565	143.955	16.1645	18.1270	34.2915	43.6545	802.8955	846.55	0.080025	1.3265	1.406525	149.535	0.26545	181.5
181.6	15.8454	402.47316	7.78288	.70856	4959.92	.020608	144.256	16.1670	18.2146	34.3816	43.6786	806.7014	850.38	.080062	1.3326	1.412662	149.636	.26560	181.6
181.7	15.8803	403.35562	7.80001	.71187	4983.09	.020651	144.557	16.1695	18.3022	34.4717	43.7027	810.5073	854.21	.080099	1.3387	1.418799	149.737	.26575	181.7
181.8	15.9152	404.24608	7.81714	.71518	5006.26	.020694	144.858	16.1720	18.3898	34.5618	43.7268	814.3132	858.04	.080136	1.3448	1.424936	149.838	.26590	181.8
181.9	15.9501	405.13254	7.83427	.71849	5029.43	.020737	145.159	16.1745	18.4774	34.6519	43.7509	818.1191	861.87	.080173	1.3509	1.431073	149.939	.26605	181.9
182.0	15.985	406.0190	7.8514	0.7218	5052.6	0.02078	145.46	16.177	18.565	34.742	43.775	821.925	865.7	0.08021	1.357	1.43221	150.04	0.2662	182.0
182.1	16.0205	406.9207	7.86884	.72534	5077.38	.020823	145.761	16.1796	18.6589	34.8385	43.7991	825.9809	869.78	.080248	1.3634	1.443648	150.14	.26636	182.1
182.2	16.0560	407.8224	7.88628	.72888	5102.16	.020866	145.062	16.1822	18.7528	34.9330	43.8232	830.0368	873.86	.080286	1.3698	1.450086	150.24	.26652	182.2
182.3	16.0915	408.7241	7.90372	.73242	5126.94	.020909	146.363	16.1848	18.8467	35.0315	43.8473	834.0927	877.94	.080324	1.3762	1.456524	150.34	.26668	182.3
182.4	16.1270	409.6258	7.92116	.73596	5151.72	.020952	146.664	16.1874	18.9406	35.1280	43.8714	838.1486	882.02	.080362	1.3826	1.462962	150.44	.26684	182.4
182.5	16.1625	410.5275	7.9386	0.73950	5176.50	0.020995	146.965	16.1900	19.0345	35.2245	43.8955	842.2045	886.10	0.080400	1.3890	1.469400	150.54	0.26700	182.5
182.6	16.1980	411.4292	7.95604	.74304	5201.28	.021038	147.266	16.1926	19.1284	35.3210	43.9196	846.2604	890.18	.080438	1.3954	1.475838	150.64	.26716	182.6
182.7	16.2335	412.3309	7.97348	.74658	5226.06	.021081	147.567	16.1952	19.2223	35.4175	43.9437	850.3163	894.26	.080476	1.4018	1.482276	150.74	.26732	182.7
182.8	16.2690	413.2326	7.99092	.75012	5251.84	.021124	147.868	16.1978	19.3162	35.5140	43.9678	854.3722	898.34	.080514	1.4082	1.488714	150.84	.26748	182.8
182.9	16.3045	414.1343	8.00836	.75366	5275.62	.021167	148.169	16.2004	19.4101	35.6105	43.9919	858.4281	902.42	.080552	1.4146	1.495152	150.94	.26764	182.9
183.0	16.340	415.0360	8.0258	0.7572	5300.4	0.02121	148.470	16.203	19.504	35.707	44.016	862.484	906.5	0.08059	1.421	1.50159	151.04	0.2678	183.0
183.1	16.3762	415.95548	8.04357	.76101	5327.07	.021254	148.778	16.2055	19.6049	35.8104	44.0401	866.8599	910.90	.080627	1.4279	1.508527	151.14	.26795	183.1
183.2	16.4124	416.87496	8.06134	.76482	5353.74	.021298	149.086	16.2080	19.7058	35.9138	44.0642	871.2358	915.30	.080664	1.4348	1.515464	151.24	.26810	183.2
183.3	16.4486	417.79444	8.07911	.76863	5380.41	.021342	149.394	16.2105	19.8087	36.0172	44.0883	875.6117	919.70	.080701	1.4417	1.522401	151.34	.26825	183.3
183.4	16.4848	418.71392	8.09688	.77244	5407.08	.021386	149.702	16.2130	19.9076	36.1206	44.1124	879.9876	924.10	.080738	1.4486	1.529338	151.44	.26840	183.4
183.5	16.5210	419.63340	8.11465	0.77625	5433.75	0.021430	150.01	16.2155	20.0085	36.2240	44.1365	884.3635	928.50	0.080775	1.4555	1.536275	151.54	0.26855	183.5
183.6	16.5572	420.53288	8.13242	.78006	5460.42	.021474	150.318	16.2180	20.1094	36.3274	44.1606	888.7394	932.90	.080812	1.4624	1.543212	151.64	.26870	183.6
183.7	16.5934	421.47236	8.15019	.78387	5487.09	.021518	150.626	16.2205	20.2103	36.4308	44.1847	893.1153	937.30	.080849	1.4693	1.550149	151.74	.26885	183.7
183.8	16.6296	422.39184	8.16796	.78764	5513.76	.021562	150.934	16.2230	20.3112	36.5342	44.2088	897.4912	941.70	.080886	1.4762	1.557086	151.84	.26900	183.8
183.9	16.6658	423.31132	8.18573	.79149	5540.43	.021606	151.242	16.2255	20.4121	36.6376	44.2329	901.8671	946.10	.080923	1.4831	1.564023	151.94	.26915	183.9
184.0	16.702	424.2308	8.2035	0.7953	5567.1	0.02165	151.55	16.228	20.513	36.741	44.257	906.243	950.5	0.08096	1.490	1.57096	152.04	0.2693	184.0
184.1	16.7389	425.16806	8.2216	.7994	5595.8	.021694	151.858	16.2305	20.6218	36.8523	44.2811	910.9389	955.22	.080998	1.4975	1.578498	152.141	.26946	184.1
184.2	16.7758	426.10532	8.2397	.8035	5624.5	.021738	152.166	16.2330	20.7306	36.9636	44.3052	915.6348	959.94	.081036	1.5050	1.586036	152.242	.26962	184.2
184.3	16.8127	427.04258	8.2578	.8076	5653.2	.021782	152.474	16.2355	20.8394	37.0749	44.3293	920.3307	964.66	.081074	1.5125	1.593574	152.343	.26978	184.3
184.4	16.8496	427.97984	8.2759	.8117	5681.9	.021826	152.782	16.2380	20.9482	37.1862	44.3534	925.0266	969.38	.081112	1.5200	1.601112	152.444	.26994	184.4

184.5	16.8865	428.91710	8.2940	0.8158	5710.6	0.021870	153.090	16.2405	21.0570	37.2975	44.3775	929.7225	974.10	0.081150	1.5275	1.608650	152.545	0.2701	184.5
184.6	16.9234	429.85436	8.3121	.8199	5739.3	.021914	153.398	16.2430	21.1658	37.4088	44.4016	934.4184	978.82	.081188	1.5350	1.616188	152.646	.27026	184.6
184.7	16.9603	430.79162	8.3302	.8240	5768.0	.021958	153.706	16.2455	21.2746	37.5201	44.4257	939.1143	983.54	.081226	1.5425	1.623726	152.747	.27042	184.7
184.8	16.9972	431.72888	8.3483	.8281	5796.7	.022002	154.014	16.2480	21.3834	37.6314	44.4498	943.8102	988.26	.081264	1.5500	1.631264	152.848	.27058	184.8
184.9	17.0341	432.66614	8.3664	.8322	5825.4	.022046	154.322	16.2505	21.4922	37.7427	44.4739	948.5061	992.98	.081302	1.5575	1.638802	152.949	.27074	184.9
185.0	17.071	433.6034	8.3845	0.8363	5854.	0.02209	154.64	16.253	21.601	37.854	44.498	953.202	997.7	0.08134	1.565	1.64634	153.05	0.2709	185.0
185.1	17.1085	434.55590	8.40293	.84072	5885.04	.022136	154.952	16.2555	21.7184	37.9739	44.5222	958.3078	1002.83	.081377	1.573	1.654377	153.15	.27105	185.1
185.2	17.1460	435.5084	8.42136	.84514	5915.58	.022182	155.274	16.2580	21.8358	38.0938	44.5464	963.4136	1007.96	.081414	1.581	1.662414	153.25	.2712	185.2
185.3	17.1835	436.4609	8.43979	.84956	5946.92	.022228	155.596	16.2605	21.9532	38.2137	44.5706	968.5194	1013.09	.081451	1.589	1.670451	153.35	.27135	185.3
185.4	17.2210	437.4134	8.45822	.85398	5977.86	.022274	155.918	16.2630	22.0706	38.3336	44.5948	973.6252	1018.22	.081488	1.597	1.678488	153.45	.2715	185.4
185.5	17.2585	438.3659	8.47665	0.8584	6008.80	0.022320	156.240	16.2655	22.1880	38.4535	44.6190	978.731	1023.35	0.081525	1.605	1.686525	153.55	0.27165	185.5
185.6	17.2960	439.3184	8.49508	.86282	6039.74	.022366	156.562	16.2680	22.3054	38.5734	44.6432	983.8368	1028.48	.081562	1.613	1.694562	153.65	.2718	185.6
185.7	17.3335	440.2709	8.51351	.86724	6070.68	.022412	156.884	16.2705	22.4228	38.6933	44.6674	988.9426	1033.61	.081599	1.621	1.702599	153.75	.27195	185.7
185.8	17.3710	441.2234	8.53194	.87166	6101.62	.022458	157.206	16.2730	22.5402	38.8132	44.6916	994.0484	1038.74	.081636	1.629	1.710636	153.85	.27210	185.8
185.9	17.4085	442.1759	8.55037	.87608	6132.56	.022504	157.528	16.2755	22.6576	38.9331	44.7158	999.1542	1043.87	.081673	1.637	1.718673	153.95	.27225	185.9
186.0	17.446	443.1284	8.5688	0.8805	6163.5	0.02255	157.85	16.278	22.775	39.053	44.740	1004.26	1049.	0.08171	1.645	1.72671	154.05	0.2724	186.0
186.1	17.4842	444.09868	8.58757	.88528	6196.96	.022596	158.172	16.2806	22.9022	39.1828	44.7641	1009.7359	1054.5	.081747	1.6536	1.735347	154.15	.27256	186.1
186.2	17.5224	445.06896	8.60634	.89006	6230.42	.022642	158.494	16.2832	23.0294	39.3126	44.7882	1015.2118	1060.0	.081784	1.6622	1.743984	154.25	.27272	186.2
186.3	17.5606	446.03924	8.62511	.89484	6263.88	.022688	158.816	16.2858	23.1566	39.4424	44.8123	1020.6877	1065.5	.081821	1.6708	1.752621	154.35	.27288	186.3
186.4	17.5988	447.00952	8.64388	.89962	6297.34	.022734	159.138	16.2884	23.2838	39.5722	44.8364	1026.1636	1071.0	.081858	1.6794	1.761258	154.45	.27304	186.4
186.5	17.6370	447.97980	8.66265	0.9044	6330.80	0.022780	159.460	16.291	23.411	39.702	44.8605	1031.6395	1076.5	0.081895	1.688	1.769895	154.55	0.27320	186.5
186.6	17.6752	448.95008	8.68142	.90518	6364.26	.022826	159.782	16.2936	23.5382	39.8318	44.8846	1037.1154	1082.	.081932	1.6966	1.778582	154.65	.27336	186.6
186.7	17.7134	449.92036	8.70019	.91396	6397.72	.022872	160.104	16.2962	23.6654	39.9616	44.9087	1042.5913	1087.5	.081969	1.7052	1.787169	154.75	.27352	186.7
186.8	17.7516	450.89064	8.71896	.91874	6431.18	.022918	160.426	16.2988	23.7926	40.0914	44.9328	1048.0672	1093.	.082006	1.7138	1.795806	154.85	.27368	186.8
186.9	17.7898	451.86092	8.73773	.92352	6464.64	.022964	160.748	16.3014	23.9198	40.2212	44.9569	1053.5431	1098.5	.082043	1.7224	1.804443	154.95	.27384	186.9
187.0	17.828	452.8312	8.7565	0.9283	6498.1	0.02301	161.07	16.304	24.047	40.351	44.981	1059.019	1104.	0.082108	1.731	1.81308	155.05	0.2740	187.0
187.1	17.8669	453.81926	8.77561	.93349	6534.43	.023056	161.392	16.3065	24.185	40.4915	45.0051	1064.9949	1110.	.082117	1.7404	1.822517	155.151	.27415	187.1
187.2	17.9058	454.80732	8.79472	.93868	6570.76	.023102	161.714	16.3090	24.323	40.6320	45.0292	1070.9708	1116.	.082154	1.7498	1.831954	155.252	.27430	187.2
187.3	17.9447	455.79538	8.81383	.94387	6607.09	.023148	162.036	16.3115	24.4610	40.7725	45.0533	1076.9467	1122.	.082191	1.7592	1.841391	155.353	.27445	187.3
187.4	17.9836	456.78344	8.83294	.94906	6643.42	.023194	162.358	16.3140	24.599	40.9130	45.0774	1082.9226	1128.	.082228	1.7686	1.850828	155.454	.27460	187.4
187.5	18.0225	457.77715	8.85205	0.9542	6679.75	0.023240	162.680	16.3165	24.737	41.0535	45.1015	1088.8985	1134.	0.082265	1.778	1.860265	155.555	0.27475	187.5
187.6	18.0614	458.75956	8.87116	.95944	6716.08	.023286	163.002	16.3190	24.875	41.1940	45.1256	1094.8744	1140.	.082302	1.7874	1.869702	155.656	.27490	187.6
187.7	18.1003	459.74762	8.89027	.96463	6752.41	.023332	163.324	16.3215	25.013	41.3345	45.1497	1100.8503	1146.	.082339	1.7968	1.879139	155.757	.27505	187.7
187.8	18.1392	460.73568	8.90938	.96982	6788.74	.023378	163.646	16.3240	25.151	41.4750	45.1738	1106.8262	1152.	.082376	1.8062	1.888576	155.858	.27520	187.8
187.9	18.1781	461.72374	8.92849	.97501	6825.07	.023424	163.968	16.3265	25.289	41.6155	45.1979	1112.8021	1158.	.082413	1.8156	1.897013	155.959	.27535	187.9
188.0	18.217	462.7118	8.9476	0.9802	6861.4	0.02347	164.29	16.329	25.427	41.756	45.222	1118.778	1164.	0.08245	1.825	1.90745	156.06	0.2755	188.0
188.1	18.2567	463.72018	8.96706	.98588	6901.16	.023519	164.633	16.3315	25.5777	41.9082	45.2461	1125.2539	1170.5	.082488	1.8353	1.917788	156.16	.27566	188.1
188.2	18.2964	464.72856	8.98652	.99156	6940.92	.023568	164.976	16.3340	25.7284	42.0604	45.2702	1131.7298	1177.	.082526	1.8456	1.928126	156.26	.27582	188.2
188.3	18.3361	465.73694	9.00598	.99724	6980.68	.023617	165.319	16.3365	25.8791	42.2126	45.2943	1138.2057	1183.5	.082564	1.8559	1.938464	156.36	.27598	188.3
188.4	18.3758	466.74532	9.02544	1.00292	7020.44	.023666	165.662	16.3390	26.0298	42.3648	45.3184	1144.6816	1190.	.082602	1.8662	1.948802	156.46	.27614	188.4
188.5	18.4155	467.75370	9.04490	1.00860	7060.20	0.023715	166.005	16.3415	26.1805	42.517	45.3425	1151.1575	1196.5	0.082640	1.8765	1.959140	156.56	0.27630	188.5
188.6	18.4552	468.76208	9.06436	1.01428	7099.96	.023764	166.348	16.3440	26.3312	42.6692	45.3666	1157.6334	1203.	.082678	1.8868	1.969478	156.66	.27646	188.6
188.7	18.4949	469.77046	9.08382	1.01996	7139.72	.023813	166.691	16.3465	26.4819	42.8214	45.3907	1164.1093	1209.5	.082716	1.8971	1.979816	156.76	.27662	188.7
188.8	18.5346	470.77884	9.10328	1.02564	7179.48	.023862	167.034	16.3490	26.6326	42.9736	45.4148	1170.5852	1216.	.082754	1.9074	1.990154	156.86	.27678	188.8
188.9	18.5743	471.78722	9.12274	1.03132	7219.24	.023911	167.377	16.3515	26.7833	43.1258	45.4389	1177.0611	1222.5	.082792	1.9117	2.000492	156.96	.27694	188.9

189.0	18.614	472.7956	9.1422	1.037	7259.	0.02396	167.72	16.354	26.934	43.288	45.463	1183.537	1229.	0.082883	1.928	2.010883	157.06	0.27710	189.0
189.1	18.6543	473.81922	9.16201	1.0432	7302.4	.02401	168.07	16.3565	27.0566	43.4531	45.4871	1190.7129	1236.2	.082867	1.9391	2.021967	157.161	.27725	189.1
189.2	18.6946	474.84284	9.18182	1.0494	7345.8	.02406	168.42	16.3590	27.2592	43.6182	45.5112	1197.8888	1243.4	.082904	1.9502	2.033104	157.262	.27740	189.2
189.3	18.7349	475.86646	9.20163	1.0556	7389.2	.02411	168.77	16.3615	27.4218	43.7833	45.5353	1205.0647	1250.6	.082941	1.9613	2.044241	157.363	.27755	189.3
189.4	18.7752	476.89008	9.22144	1.0618	7432.6	.02416	169.12	16.3640	27.5844	43.9484	45.5594	1212.2406	1259.8	.082978	1.9724	2.055318	157.464	.2777	189.4
189.5	18.8155	477.91370	9.24125	1.0680	7476.0	0.02421	169.47	16.3665	27.7470	44.1135	45.5835	1219.4165	1268.0	0.083015	1.9835	2.066515	157.565	0.27785	189.5
189.6	18.8558	478.93732	9.26106	1.0742	7519.4	.02426	169.82	16.3690	27.9096	44.2786	45.6076	1226.5924	1272.2	.083052	1.9946	2.077652	157.666	.2780	189.6
189.7	18.8961	479.96094	9.28087	1.0804	7562.8	.02431	170.17	16.3715	28.0722	44.4437	45.6317	1233.7683	1279.4	.083089	2.0057	2.088789	157.767	.27815	189.7
189.8	18.9364	480.98456	9.30068	1.0866	7606.2	.02436	170.52	16.3740	28.2348	44.6088	45.6558	1240.9442	1286.6	.083126	2.0168	2.099926	157.868	.2783	189.8
189.9	18.9767	482.00818	9.32049	1.0928	7649.6	.02441	170.87	16.3765	28.3974	44.7739	45.6799	1248.1201	1293.8	.083163	2.0279	2.111063	157.969	.27845	189.9
190.0	19.017	483.0318	9.3403	1.099	7693.	0.02446	171.22	16.379	29.560	44.939	45.704	1255.296	1301.	0.083230	2.039	2.11222	158.07	0.2786	190.0
190.1	19.0580	484.0732	9.36047	1.1057	7739.9	.024506	171.542	16.3816	28.7425	45.1241	45.7282	1262.9718	1308.7	.083237	2.0512	2.134437	158.17	.27876	190.1
190.2	19.0990	485.1146	9.38064	1.1124	7786.8	.024552	171.864	16.3842	28.9250	45.3092	45.7524	1270.6476	1316.4	.083274	2.0634	2.146674	158.27	.27892	190.2
190.3	19.1400	486.1560	9.40081	1.1191	7833.7	.024598	172.186	16.3868	29.1075	45.4943	45.7766	1278.3234	1324.1	.083311	2.0756	2.158911	158.37	.27908	190.3
190.4	19.1810	487.1974	9.42098	1.1258	7880.6	.024644	172.508	16.3894	29.2900	45.6794	45.8008	1285.9992	1331.8	.083348	2.0878	2.171148	158.47	.27924	190.4
190.5	19.222	488.2388	9.44115	1.1325	7927.5	0.024690	172.830	16.392	29.4725	45.8645	45.825	1293.675	1339.5	0.083385	2.100	2.183385	158.57	0.27940	190.5
190.6	19.2630	489.2802	9.46132	1.1392	7974.4	.024736	173.152	16.3946	29.6550	46.0496	45.8492	1301.3508	1347.2	.083422	2.1122	2.195422	158.67	.27956	190.6
190.7	19.3040	490.3216	9.48149	1.1459	8021.3	.024752	173.474	16.3972	29.8375	46.2347	45.8734	1309.0266	1354.9	.083459	2.1244	2.207859	158.77	.27972	190.7
190.8	19.3450	491.3630	9.50166	1.1526	8068.2	.024828	173.796	16.3998	30.0206	46.4198	45.8976	1316.7024	1362.6	.083496	2.1366	2.220096	158.87	.27988	190.8
190.9	19.3860	492.4044	9.52183	1.1593	8115.1	.024874	174.118	16.4024	30.2025	46.6049	45.9218	1324.3782	1370.3	.083533	2.1488	2.232333	158.97	.28004	190.9
191.0	19.427	493.4458	9.5420	1.166	8162.	0.02492	174.44	16.405	30.385	46.790	45.946	1332.054	1378.	0.08357	2.161	2.24457	159.07	0.28020	191.0
191.1	19.4688	494.50752	9.56253	1.1735	8214.5	.024971	174.797	16.4075	30.584	46.9915	45.9701	1340.6299	1386.6	.083607	2.1745	2.258107	159.17	.28035	191.1
191.2	19.5106	495.56924	9.58306	1.1810	8267.0	.025022	175.154	16.4100	30.783	47.1930	45.9942	1349.2058	1395.2	.083644	2.1880	2.271644	159.27	.28050	191.2
191.3	19.5524	496.63096	9.60359	1.1885	8319.5	.025073	175.511	16.4125	30.9820	47.3945	46.0183	1357.7817	1403.8	.083681	2.2015	2.285181	159.37	.28065	191.3
191.4	19.5942	497.69268	9.62412	1.1960	8372.0	.025124	175.868	16.4150	31.1810	47.5960	46.0424	1366.3576	1412.4	.083718	2.2150	2.308718	159.47	.28080	191.4
191.5	19.6360	498.75440	9.64465	1.2035	8424.5	0.025175	176.225	16.4175	31.3800	47.7975	46.0665	1374.9335	1421.	0.083755	2.2285	2.312255	159.57	0.28095	191.5
191.6	19.6778	499.81612	9.66518	1.2110	8477.0	.025226	176.582	16.4200	31.579	47.9990	46.0906	1383.5094	1429.6	.083792	2.2420	2.325792	159.67	.28110	191.6
191.7	19.7196	500.87784	9.68571	1.2185	8529.5	.025277	176.939	16.4225	31.778	48.2005	46.1147	1392.0853	1438.2	.083829	2.2555	2.339329	159.77	.28125	191.7
191.8	19.7614	501.93956	9.70624	1.2260	8582.0	.025328	177.296	16.4250	31.9770	48.4020	46.1388	1400.6612	1446.8	.083866	2.2690	2.352866	159.87	.28140	191.8
191.9	19.8032	503.00128	9.72677	1.2335	8634.5	.025379	177.653	16.4275	32.1760	48.6035	46.1629	1409.2371	1455.4	.083903	2.2825	2.366403	159.97	.28155	191.9
192.0	19.845	504.0630	9.7473	1.241	8687.0	0.02543	178.01	16.430	32.375	48.805	46.187	1417.813	1464.	0.08394	2.296	2.379940	160.07	0.2817	192.0
192.1	19.8876	505.14504	9.7682	1.2493	8745.1	.025481	178.367	16.4325	32.5956	49.0281	46.2111	1427.2889	1473.5	.083977	2.3108	2.394777	160.171	.28186	192.1
192.2	19.9302	506.22708	9.7891	1.2576	8803.2	.025532	178.724	16.4350	32.8162	49.2512	46.2352	1436.7648	1483.	.084014	2.3256	2.409614	160.272	.28202	192.2
192.3	19.9728	507.30912	9.8100	1.2659	8861.3	.025583	179.081	16.4375	32.0368	49.4743	46.2593	1446.2407	1492.5	.084051	2.3404	2.424451	160.373	.28218	192.3
192.4	20.0154	508.39116	9.8309	1.2742	8919.4	.025634	179.438	16.4400	33.2578	49.6974	46.2834	1455.7166	1502.	.084088	2.3552	2.439288	160.474	.28234	192.4
192.5	20.0580	509.47320	9.8518	1.2825	8977.5	0.025685	179.795	16.4425	33.4780	49.9205	46.3075	1465.1725	1511.5	0.084125	2.370	2.454125	160.575	0.28250	192.5
192.6	20.1006	510.55524	9.8727	1.2908	9035.6	.025736	180.152	16.4450	33.6986	50.1436	46.3316	1474.6684	1521.	.084162	2.3848	2.468962	160.676	.28266	192.6
192.7	20.1432	511.63728	9.8936	1.2991	9093.7	.025787	180.509	16.4475	33.9192	50.3667	46.3557	1484.1443	1530.5	.084199	2.3996	2.483799	160.777	.28282	192.7
192.8	20.1858	512.71932	9.9145	1.3074	9151.8	.025838	180.866	16.4500	34.1398	50.5898	46.3798	1493.6202	1540.	.084236	2.4144	2.498636	160.878	.28298	192.8
192.9	20.2284	513.80136	9.9354	1.3157	9209.9	.025889	181.223	16.4525	34.3604	50.8129	46.4059	1503.0961	1549.5	.084273	2.4292	2.513473	160.979	.28314	192.9
193.0	20.271	514.8834	9.9563	1.324	9268.	0.02594	181.58	16.455	34.581	51.036	46.428	1512.372	1559.	0.08431	2.444	2.52831	161.08	0.28330	193.0
193.1	20.3143	515.98322	9.97757	1.3332	9332.4	.025992	181.944	16.4575	34.8265	51.2840	46.4522	1523.2378	1569.7	.084347	2.4605	2.544847	161.18	.28345	193.1
193.2	20.3576	517.08304	9.99884	1.3424	9396.8	.026044	182.308	16.4600	35.0720	51.5320	46.4764	1533.9036	1580.4	.084384	2.4770	2.561384	161.28	.28360	193.2
193.3	20.4009	518.18286	10.02011	1.3516	9461.2	.026096	182.672	16.4625	35.3175	51.7800	46.5006	1544.5694	1591.1	.084421	2.4935	2.577921	161.38	.28375	193.3
193.4	20.4442	519.28268	10.04138	1.3608	9525.6	.026148	183.036	16.4650	35.5630	52.0280	46.5248	1555.2352	1601.8	.084458	2.5100	2.594458	161.48	.28390	193.4

193.5	20.4875	520.38250	10.06265	1.3760	9590.	0.026200	183.400	16.4675	35.8085	52.2760	46.549	1565.901	1612.5	0.084495	2.5265	2.610995	161.58	0.28405	193.5
193.6	20.5308	521.48232	10.08392	1.3792	9654.4	.026252	183.764	16.4700	36.0540	52.5240	46.5732	1576.5668	1623.2	.084532	2.5430	2.627532	161.68	.28420	193.6
193.7	20.5741	522.58214	10.10519	1.3884	9718.8	.026304	184.128	16.4725	36.2995	52.7720	46.5974	1587.2326	1633.9	.084569	2.5595	2.644069	161.78	.28435	193.7
193.8	20.6174	523.68196	10.12646	1.3976	9783.2	.026356	184.492	16.4750	36.5450	53.0200	46.6216	1597.8984	1644.6	.084606	2.5760	2.660606	161.88	.28450	193.8
193.9	20.6607	524.78178	10.14773	1.4068	9847.6	.026408	184.856	16.4775	36.7905	53.2680	46.6458	1608.5642	1655.3	.084643	2.5925	2.677143	161.98	.28465	193.9
194.0	20.704	525.8816	10.1690	1.416	9912.	0.02646	185.22	16.480	37.036	53.516	46.670	1619.23	1666.	0.084680	2.6090	2.693680	162.08	0.2848	194.0
194.1	20.7481	527.00174	10.1907	1.4263	9984.1	.026512	185.584	16.4826	37.3109	53.7935	46.6941	1631.0159	1677.8	.084717	2.6275	2.712217	162.181	.28496	194.1
194.2	20.7922	528.12188	10.2124	1.4366	10056.2	.026564	185.948	16.4852	37.5858	54.0710	46.7182	1642.8018	1689.6	.084754	2.646	2.730754	162.282	.28512	194.2
194.3	20.8363	529.24202	10.2341	1.4469	10128.3	.026616	186.312	16.4878	37.8607	54.3485	46.7423	1654.5877	1701.4	.084791	2.6645	2.749291	162.383	.28528	194.3
194.4	20.8804	530.36216	10.2558	1.4572	10200.4	.026668	186.676	16.4904	38.1356	54.6260	46.7664	1666.3736	1713.2	.084828	2.6830	2.767828	162.484	.28544	194.4
194.5	20.9245	531.8230	10.2775	1.4675	10272.5	0.026720	187.040	16.4930	38.4105	54.9035	46.7905	1678.1595	1725.	0.084865	2.7015	2.786365	162.585	0.28560	194.5
194.6	20.9686	532.60244	10.2992	1.4778	10344.6	.026772	187.404	16.4956	38.6854	55.1810	46.8146	1699.9454	1736.8	.084902	2.7200	2.804902	162.686	.28576	194.6
194.7	21.0127	533.72258	10.3209	1.4881	10416.7	.026824	187.768	16.4982	38.9603	55.4585	46.8387	1701.7313	1748.6	.084939	2.7385	2.823439	162.787	.28592	194.7
194.8	21.0568	534.84272	10.3426	1.4984	10488.8	.026876	188.132	16.5008	39.2352	55.7360	46.8628	1713.5172	1760.4	.084976	2.7570	2.831976	162.888	.28608	194.8
194.9	21.1009	535.96286	10.3643	1.5087	10560.9	.026928	188.496	16.5034	39.5101	56.0135	46.8869	1725.3031	1772.2	.085013	2.7755	2.860513	162.989	.28624	194.9
195.0	21.145	537.0830	10.386	1.519	10633.	0.02698	188.86	16.506	39.785	56.291	46.911	1737.089	1784.	0.08505	2.7940	2.87905	163.09	0.2864	195.0
195.1	21.1899	538.22346	10.408	1.5306	10714.2	.027033	189.231	16.5085	40.095	56.6035	46.9352	1750.4648	1797.4	.085087	2.8148	2.899887	163.19	.28655	195.1
195.2	21.2348	539.36392	10.430	1.5422	10795.4	.027086	189.602	16.5110	40.405	56.9160	46.9594	1763.8406	1810.8	.085124	2.8356	2.920724	163.29	.28670	195.2
195.3	21.2797	540.50438	10.452	1.5538	10876.6	.027139	189.973	16.5135	40.715	57.2285	46.9836	1777.2164	1824.2	.085161	2.8564	2.941561	163.39	.28685	195.3
195.4	21.3246	541.64484	10.474	1.5654	10957.8	.027192	190.344	16.5160	41.025	57.5410	47.0078	1790.5922	1837.6	.085198	2.8772	2.962398	163.49	.28700	195.4
195.5	21.3695	542.78530	10.496	1.5770	11039.0	0.027245	190.715	16.5185	41.335	57.8535	47.032	1803.9680	1851.	0.085235	2.8980	2.983235	163.59	0.28715	195.5
195.6	21.4144	543.92576	10.518	1.5886	11120.2	.027298	191.086	16.521	41.645	58.1660	47.0562	1817.3438	1864.4	.085272	2.9188	3.004072	163.69	.28730	195.6
195.7	21.4593	545.06622	10.540	1.6002	11201.4	.027351	191.457	16.5235	41.955	58.4785	47.0804	1830.7196	1877.8	.085309	2.9396	3.024909	163.79	.28745	195.7
195.8	21.5042	546.20668	10.562	1.6118	11282.6	.027404	191.828	16.5260	42.265	58.7910	47.1046	1844.0954	1891.2	.085346	2.9604	3.045746	163.89	.28760	195.8
195.9	21.5491	547.34714	10.584	1.6234	11363.8	.027457	192.199	16.5285	42.575	59.1035	47.1288	1857.4712	1904.6	.085383	2.9812	3.066583	163.99	.28775	195.9
196.0	21.594	548.4876	10.606	1.635	11445.	0.027511	192.57	16.531	42.885	59.416	47.153	1870.847	1918.	0.08542	3.002	3.08742	164.09	0.2879	196.0
196.1	21.6396	549.64584	10.6284	1.6482	11537.4	.027565	192.952	16.5335	43.2367	59.7702	47.1771	1885.9229	1933.1	.085457	3.0256	3.111057	164.191	.28806	196.1
196.2	21.6852	550.80406	10.6508	1.6614	11629.8	.027619	193.334	16.536	43.5884	60.1244	47.2012	1900.9988	1948.2	.085494	3.0492	3.134694	164.292	.28822	196.2
196.3	21.7308	551.96232	10.6732	1.6746	11722.2	.027673	193.716	16.5385	43.9401	60.4786	47.2253	1916.0747	1963.3	.085531	3.0728	3.168331	164.393	.28838	196.3
196.4	21.7764	553.12056	10.6956	1.6878	11814.6	.027728	194.098	16.541	44.2918	60.8328	47.2494	1931.1506	1978.4	.085568	3.0964	3.181968	164494	.28854	196.4
196.5	21.822	554.27880	10.7180	1.7010	11907.	0.027782	194.480	16.5435	44.6435	61.1870	47.2735	1946.2265	1993.5	0.085605	3.120	3.205605	164.594	0.28870	196.5
196.6	21.8676	555.43704	10.7404	1.7142	11999.4	.027837	194.862	16.5460	44.9952	61.5412	47.2976	1961.3024	2008.6	.085642	3.1436	3.229242	164.696	.28886	196.6
196.7	21.9132	556.59528	10.7628	1.7274	12091.8	.027891	195.244	16.5485	45.3469	61.8954	47.3217	1976.3783	2023.7	.085679	3.1672	3.252879	164.797	.28902	196.7
196.8	21.9588	557.75352	10.7852	1.7406	12184.2	.027946	195.626	16.551	45.6986	62.2496	47.3458	1991.4542	2038.8	.085716	3.1908	3.276516	164.898	.28918	196.8
196.9	22.0044	558.91176	10.8076	1.7538	12276.6	.028000 5	196.008	16.5535	46.0503	62.6038	47.3699	2006.5301	2053.9	.085753	3.2144	3.300153	164.999	.28934	196.9
197.0	22.050	560.0700	10.830	1.7767	12369.	0.028055	196.385	16.556	46.402	62.958	47.394	2021.606	2069.	0.08579	3.238	3.32379	165.1	0.2895	197.0
197.1	22.0964	561.24856	10.8528	1.782	12474.	.028110 5	196.769	16.5585	46.8044	63.3629	47.4182	2038.9818	2086.4	.085827	3.2649	3.350727	165.2	.28965	197.1
197.2	22.1428	562.42712	10.8756	1.797	12579.	.028166 0	197.158	16.561	47.2068	63.7678	47.4424	2056.3576	2103.8	.085864	3.2918	3.377664	165.3	.28980	197.2
197.3	22.1892	563.60568	10.8984	1.812	12684.	.028322 1 5	197.547	16.5635	47.6092	64.1727	47.4666	2073.7334	2121.2	.085901	3.3187	3.404601	165.4	.28995	197.3
197.4	22.2356	564.78424	10.9212	1.827	12789.	.028227 0	197.936	16.5660	48.0116	64.5776	47.4908	2091.1092	2138.6	.085938	3.3456	3.431538	165.5	.2901	197.4
197.5	22.2820	565.9628	10.9440	1.842	12894.	0.028332 5	198.325	16.5685	48.4140	64.9825	47.515	2108.4850	2156.	0.085975	3.3725	3.458475	165.6	0.29025	197.5
197.6	22.3284	567.14136	10.9668	1.857	12999.	.028388 0	198.714	16.571	48.8164	65.3874	47.5392	2125.8608	2173.4	.086012	3.3994	3.485412	165.7	.29040	197.6
197.7	22.3748	568.31992	10.9896	1.872	13104.	.028443 5	199.103	16.5735	49.2188	65.7923	47.5634	2143.2366	2190.8	.086049	3.4263	3.512349	165.8	.29055	197.7
197.8	22.4212	569.49848	11.0124	1.887	13209.	.028499 0	199.492	16.576	49.6212	66.1972	47.5876	2160.6124	2208.2	.086086	3.4532	3.530286	165.9	.29070	197.8
197.9	22.4676	570.67704	11.0352	1.902	13314.	.028554 5	199.881	16.5785	50.0236	66.6021	47.6118	2177.9882	2225.6	.086123	3.4801	3.566223	166.0	.29085	197.9

198.0	22.514	571.8556	11.058	1.917	13 419.	0.02861	200.27	16.581	50.426	67.007	47.636	2195.364	2243.	0.08616	3.507	3.59316	166.1	0.2910	198.0
198.1	22.5613	573.05672	11.0812	1.9344	13 540.8	.028666	200.662	16.5838	50.8908	67.4744	47.6601	2215.3399	2263.	.086197	3.538	3.624197	166.201	.29115	198.1
198.2	22.6086	574.25784	11.1044	1.9518	13 662.6	.028722	201.054	16.5862	51.3556	67.9418	47.6842	2235.3158	2283.	.086234	3.569	3.655234	166.302	.29130	198.2
198.3	22.6559	575.45896	11.1276	1.9692	13 784.4	.028778	201.446	16.5888	51.8204	68.4092	47.7083	2255.2917	2303.	.086271	3.600	3.686271	166.403	.29145	198.3
198.4	22.7032	576.66008	11.1508	1.9866	13 906.2	.028830	201.838	16.5914	52.2852	68.8766	47.7324	2275.2676	2323.	.086308	3.631	3.717308	166.504	.29160	198.4
198.5	22.7505	577.86120	11.1740	2.0040	14 028.0	0.028890	202.230	16.5940	52.7500	69.3440	47.7565	2295.2435	2343.	0.086345	3.662	3.748345	166.605	0.29175	198.5
198.6	22.7978	579.06232	11.1972	2.0214	14 149.8	.028946	202.622	16.5966	53.2148	69.8114	47.7806	2315.2194	2363.	.086382	3.693	3.779382	166.706	.29190	198.6
198.7	22.8451	580.26344	11.2204	2.0388	14 271.6	.029002	203.014	16.5992	53.6796	70.2788	47.8047	2335.1953	2383.	.086419	3.724	3.810419	166.807	.29205	198.7
198.8	22.8924	581.46456	11.2436	2.0562	14 393.4	.029058	203.406	16.6018	54.1444	70.7462	47.8288	2355.1712	2403.	.086456	3.755	3.841456	166.908	.29220	198.8
198.9	22.9397	582.66568	11.2668	2.0736	14 515.2	.029114	203.790	16.6044	54.6092	71.2136	47.8529	2375.1471	2423.	.086493	3.786	3.872493	167.009	.29235	198.9
199.0	22.987	583.8668	11.2900	2.091	14 637.	0.02917	204.19	16.607	55.074	71.681	47.877	2395.123	2443.	0.086530	3.817	3.903530	167.11	0.2925	199.0
199.1	23.0351	585.08884	11.3136	2.1114	14 779.8	.029228	204.596	16.6095	55.6176	72.2271	47.9012	2418.4988	2466.4	.086566	3.8532	3.939766	167.21	.29265	199.1
199.2	23.0832	586.31088	11.3372	2.1518	14 922.6	.029286	205.002	16.6120	56.1612	72.7732	47.9254	2441.8946	2489.8	.086602	3.8894	3.976002	167.31	.2928	199.2
199.3	23.1313	587.53292	11.3608	2.1522	15 065.4	.029344	205.408	16.6145	56.7048	73.3193	47.9496	2465.2504	2513.2	.086638	3.9256	4.012238	167.41	.29295	199.3
199.4	23.1794	588.75496	11.3844	2.1726	15 208.2	.029402	205.814	16.6170	57.2484	73.8654	47.9738	2488.6262	2536.6	.086674	3.9618	4.048474	167.51	.29310	199.4
199.5	23.2275	589.97700	11.4080	2.1930	15 351.0	0.029460	206.220	16.6195	57.7920	74.4115	47.9738	2512.0020	2560.	0.086710	3.998	4.084710	167.61	0.29325	199.5
199.6	23.2756	591.19904	11.4316	2.2134	15 493.8	.029518	206.626	16.6220	58.3356	74.9576	48.0222	2535.3778	2583.4	.086746	4.0342	4.120946	167.71	.2934	199.6
199.7	23.3237	592.42108	11.4552	2.2338	15 636.6	.029576	207.032	16.6245	58.8792	75.5037	48.0464	2558.7536	2606.8	.086782	4.0704	4.157182	167.81	.29355	199.7
199.8	23.3718	593.64312	11.4788	2.2542	15 779.4	.029634	207.438	16.6270	59.4228	76.0498	48.0706	2582.1294	2630.2	.086818	4.1066	4.193418	167.91	.29370	199.8
199.9	23.4199	594.86516	11.5024	2.2746	15 922.2	.029692	207.844	16.6295	59.9664	76.5959	48.0948	2605.5052	2653.6	.086854	4.1428	4.229654	168.01	.29385	199.9
200.0	23.468	596.0872	11.526	2.295	16.065.0	0.0 2975	208.25	16632	60.510	77.142	48.119	2628.881	2677.	0.08689	4.1790	4.26589	168.11	0.29400	200.0

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